MINISTRY OF
AGRICULTURE, FISHERIES AND FOOD

COSTS AND EFFICIENCY IN MILK PRODUCTION

A Report of the National Investigation into the Economics of Milk Production

1955-1957

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FOREWORD

This report presents facts and figures about the profitability of milk production. It examines the reasons why profits from dairying vary widely from farm to farm, and discusses some of the means by which they can be increased on individual farms. It provides guidance to farmers and farm advisers in their efforts to improve the management of dairy herds.

The report is a product of the *National Investigation into the Economics of Milk Production*, which is undertaken by the Provincial Agricultural Economics Service with the assistance of the Milk Marketing Board and the Ministry of Agriculture, Fisheries and Food. The conduct of the Investigation and the preparation of this report were primarily the responsibility of a committee under the chairmanship of Mr. D. H. Dinsdale, O.B.E., M.A., F.R.Econ.S., who, before his retirement this year, was Provincial Agricultural Economist at King's College, Newcastle. His able direction of the work of the Committee and his personal contributions to the knowledge of the subject over a long period of years are gratefully acknowledged.

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Chief Agricultural Economist

Ministry of Agriculture, Fisheries and Food
December 1959

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INTRODUCTION

Dairying is the most important of the many enterprises in British farming. For many years, therefore, the economics of the production of milk has been of major concern not only to farmers but also to many research workers and organizations within or associated with the agricultural industry, as well as to the public at large.

As early as 1934 a "National Investigation into the Economics of Milk Production" sponsored and financed jointly by the then newly created Milk Marketing Board and the Ministry of Agriculture, was undertaken by the Provincial Agricultural Economists attached to various Universities and Colleges in England and Wales.* This investigation, which was concentrated on the determination and analysis of farm costs of milk production, was continued without a break until 1952. It was then decided that research of a more general character should be undertaken and that the costing of milk production on the farm should be confined to regular but limited periods.

After a three-year period of general research† a further national costings investigation was carried out throughout England and Wales between October 1955 and September 1957. The results form the subject-matter of this report, which it is hoped will not only be a source of useful data for those directly concerned in agricultural affairs, but will also encourage a better general understanding of the complexities of milk production and provide some guidance on methods of profitable dairy farming.

Inevitably most of the figures to be presented and discussed are averages derived from groups of farms, arranged in one way and another, to illustrate associations between particular practices in herd management, and their comparative profitabilities and economic efficiency. Such averages invariably lie within wide extremes for individual farms. This is because of the very diversified conditions in which milk production is carried on and the wide variation from farm to farm in the efficiency of production. For these reasons, the average figures can be misleading; but, if the figures are interpreted carefully, some valuable conclusions are revealed.

There are two particular difficulties on which comment should be made at this stage. First, the investigations were confined to the dairy herds (cows and followers) and the resources used for milk production. They did not embrace the whole economies of the farms of which the herds were part. Consequently, judgments about management efficiency and the profitability of dairy farming must be limited to some extent. For example, the average annual milk yield per cow for the 438 herds costed in 1955–56 was about 800 gallons with an average net margin per cow of some £33. A single herd with a yield of 700 gallons and a margin of £20 per cow might therefore be described as 'below average' and it might be inferred that the management efficiency of the herd offered considerable scope for improvement. It could be, however, that such a herd occupied a subsidiary place in a farming system integrated in such a way that a change of policy designed to achieve higher yields and margins per cow would require a diversion of resources from more profitable uses. Any further capital invested in dairying on that farm might yield a lower return than if invested in some other enterprise. In such a herd the management might well be judged to be highly efficient in the context of that particular farm organization.

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*The Addresses of Provincial Agricultural Economics Departments are given in the Appendix.

†A synopsis of the results of the research undertaken during this period has been published in "Some Aspects of Dairy Economics," H.M.S.O. 1958, price 3s. 6d. (by post 3s. 10d.).

A second general difficulty centres on the impossibility of isolating cause and effect relations between a particular resource input and results which depend on a number of factors used in combination. The techniques of the controlled experiment, in which the results from a single variable factor operate in a constant environment of associated factors, cannot be applied in economic investigations pursued on farms operating for commercial ends. Many of the relationships to be illustrated later between a particular economic feature and a general result are to be regarded, therefore, as *associations* rather than cause and effect relationships. For example, an analysis of the information revealed that, on average, herds producing between 52 and 56 per cent of their milk during the winter achieved a margin of £36 7*s*. per cow, while herds producing under 36 per cent of their milk in winter had an average margin of £24 12*s*. It would be an over-simplification to argue from these figures that the simple fact of producing more winter milk will ensure higher profits. What is much more likely is that farmers who were alert to the advantages of winter milk production were also likely to be alert to the many other aspects and practices which led to higher profitability.

Nevertheless, provided that the limitations of the material are borne in mind, some interesting results emerge from the investigation. The initial chapters of this report describe the background to the study and give details of average production costs in 1955–57. Further chapters then discuss the wide range in costs and profits from herd to herd. They reveal four key factors affecting the profitability of an individual herd, i.e., yield, feed consumption, labour use and the herd replacement policy adopted by the farmer. Each of these factors is examined in turn, and ways in which they may be used to increase profits are demonstrated. Some information is also presented on the costs of rearing replacements and producing home-grown feeds for the dairy herd.

I. THE FARMS IN THE STUDY

Although dairy farming in this country is responsible for a direct output of milk and milk products valued at £350 million annually, most dairy farmers have relatively small businesses. The average size of dairy herds in England and Wales is about 17 cows. Admittedly the one-tenth of dairy farmers with herds of more than 40 cows are responsible for about one-quarter of the milk produced each year, but some 70 per cent of all milk producers have less than 20 cows. Consequently, in considering the organization and management of individual dairy herds, the importance of the farmers with less than 20 cows should not be disregarded. This report will show that although many production methods are common to herds of all sizes, there are some problems which are of greatest concern to the smaller producer; and all efforts to improve the efficiency of milk production will not succeed until the smaller producer can be shown how to reduce his costs of producing a gallon of milk.

Choosing the Sample

When studying such a widespread industry as dairying, it is desirable that the farms included in the study should represent the many different systems of dairying found in various parts of the country. Unfortunately there are no means of selecting groups of dairy farms for this kind of study in such a way as to ensure that they represent a cross-section of all types of dairy farms in their due proportions. There are many reasons for this. For instance, although groups of farms can be chosen which are representative as far as size-of-herd is concerned, there is no guarantee that the groups would adequately reflect different systems of farming or herd management. Indeed, until more information is available about the total numbers of dairy farms of different types, it is not possible to say whether or not a particular sample is representative of the various farming types. Similarly, it is not possible to ensure beforehand that the sample is representative of such other aspects as methods of milking, yields, seasonality of production, and so on. Finally, all farmers co-operating in the study were asked to keep detailed records—a task which itself restricts the sample to those farmers who are not averse to record-keeping.

Therefore, the sample of farms studied was not necessarily representative of all aspects of dairying in the country. Nevertheless, an attempt was made to obtain a sample broadly representative as far as size of herd was concerned, and which reflected the relative importance of dairying in different parts of the country. Table I compares the size-of-herd and the regional distribution of the sample herds with the national distribution.

With regard to herd size, the sample included a higher proportion of large herds than existed in the country generally. However, since there are relatively few large herds, a larger sampling fraction is desirable in order to obtain more accurate information relating to the bulk of the milk supply. The regional distribution of the sample broadly followed the national pattern, except that Wales was somewhat under-represented.

The study was confined to herds primarily concerned with the production of milk for sale, and to herds from which at least 70 per cent of the milk was sold wholesale, i.e., producer-retailers were excluded from the study. There were no restrictions as to the proportion of graded to non-graded producers included in the sample. The outcome was that more than 90 per cent of the herds studied were either T.T. or Attested, compared with only three-quarters of the national herd.

In 1955–56 detailed records were obtained in respect of 438 herds; there were 414 herds in the study in 1956–57, including 366 herds from which records were obtained in 1955–56.

Description of the Farms

Many types of dairy farms were included in the study—from small units with a heavy dependence on purchased concentrates to large-scale arable farms where the dairy enterprise was subsidiary to and dependent on the arable system. Different methods of feeding are studied in later sections of this report; also the labour requirements of different types of housing are examined. In general, however, the system of dairying was largely determined by the size of the farms concerned. Table 2 gives details of the cropping and the stocking rates of dairy cows on farms of different sizes.

TABLE 1

Distribution of Herds by Size of Herd, and M.M.B. Region

Av. Size of Herd	Up to 9·9 cows	10– 19·9 cows	20– 29·9 cows	30– 39·9 cows	40– 49·9 cows	50– 59·9 cows	60 cows & over	All Herds
				per cent				
Sample Herds	16·9	31·5	19·8	12·1	7·8	4·1	7·8	100·0
National Herd	31·9	37·3	16·2	7·2	3·5	1·8	2·1	100·0

M.M.B. Region	Northern	North Western	Eastern	East Midlands	West Midlands	North Wales	South Wales	Southern	Mid Western	Far Western	South Eastern	All Regions
						per cent						
Sample Herds	11·9	17·6	7·1	9·1	6·4	2·3	4·3	7·5	13·0	11·8	8·9	100·0
National Herd	11·2	20·8	5·0	5·4	8·8	7·1	10·4	4·6	8·9	12·7	5·1	100·0

Source: 1955–56 *Sample and M.M.B. Census June* 1955

As would be expected, the larger herds were on the larger farms, but the proportion of the farm area devoted to dairying declined steadily with increasing size of farm. Whereas almost the whole of the smaller farms were devoted to dairying, only about one-half of the acreage on the larger farms was used by the dairy herds. Incomes from dairying on the smaller farms were supplemented mainly by pigs and poultry, but the larger farms had substantial cash-crop acreages in addition to the livestock enterprises.

A large proportion of the grassland acreage, particularly on the smaller farms, consisted of permanent pasture. Only on farms of 150 acres and above did the acreage of temporary grass equal or exceed that of permanent grass. The shortage of land on the smaller farms was reflected in the density of stocking—each cow and its followers was kept on 1·8 acres on the smallest farms whereas about 3 acres was the normal requirement on the large farms.

TABLE 2

*Description of Farms in the Sample**

Farm Size (acres)	Under 25	25–49·9	50–99·9	100–149·9	150–199·9	200–299·9	300 and over	All Herds
No. of Herds	50	73	110	68	49	36	40	426
Av. Size of Farm	17	38	75	125	173	247	463	132
Av. Size of Herd	8·2	12·5	19·8	29·1	37·1	42·6	58·6	26·3
Av. Rent per Acre	£4 4*s.*	£3 4*s.*	£2 16*s.*	£2 12*s.*	£2 11*s.*	£2 11*s.*	£2 3*s.*	£2 11*s.*
Av. Rent per Farm (£)	71	121	212	323	426	618	1005	336
	Acres per Farm							
Permanent Grass	12	23	36	53	58	76	99	45
Rough Grazing and Orchards with Grazing Value	–	1	3	7	8	8	11	5
Temporary Grass	3	7	17	30	49	72	119	33
Total Grassland	15	31	56	90	115	156	229	83
Tillage	2	6	17	32	54	85	224	46
Roads, Buildings etc.	–	1	2	3	4	6	10	3
Total Acres	17	38	75	125	173	247	463	132
Acres Devoted to:								
Milking Herd	13	23	42	64	78	94	132	57
Followers	2	7	15	25	33	42	58	22
Dairy Enterprise	15	30	57	89	111	136	190	79
Dairy Enterprise Acres as per cent of Total Acres	88	79	76	71	64	55	41	60
Livestock Acres per Cow†	1·8	2·4	2·9	3·1	3·0	3·2	3·2	3·0

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* Averages of 1955–6 and 1956–7.

† Livestock Acres are the acres of grass, cereals, roots and other crops grown for the milking herd and followers.

Rent per acre was generally lower on large farms than on small ones, ranging from 84*s*. an acre on the smallest farms to about 42*s*. an acre on the largest farms. It is interesting to note, however, that the average rent paid on the farms of less than 25 acres was some £70, or less than 30*s*. per week, for the land, buildings and farmhouse. Even on farms of 25–50 acres the average rent was only about 45*s*. per week.

Breeds

Friesians and Ayrshires were the two most popular breeds of cow on the sample farms—35 per cent of all the herds were Friesian, and a further 25 per cent were Ayrshire. Shorthorns were found on 15 per cent of the farms, whilst only 12 per cent of the herds were classified as "mixed."

Types of Buildings

Information collected about the buildings used for milk production on the survey farms was limited to the type of housing of the dairy cows. Some 85 per cent of the herds were kept in cowsheds, of which rather more than one-half were specially constructed cowsheds of various ages, the others being farm buildings converted to cowsheds. With the exception of seven herds which were kept out-of-doors throughout the year, the remainder of the herds —nearly 15 per cent—were kept in yards during the winter months.

Water Supply

About 85 per cent of the farms with less than 20 cows had adequate supplies of piped water in the cowsheds and for washing and cooling the milk, whereas virtually all the larger herds were adequately supplied with piped water in the buildings. Similarly the larger herds were better supplied with piped water in the fields—some 90 per cent had adequate piped supplies compared with only 50–60 per cent of the smaller herds. Consequently, only 10 per cent of the larger herds had to rely upon streams, ponds or wells for water in the fields, with the attendant dangers of contamination and disease. On the other hand, 40 per cent of the herds of less than 20 cows depended upon ponds, wells or streams in the fields.

Cooling and Sterilizing Equipment

In recent years, the popularity of in-churn cooling and other methods of cooling milk have been increasing at the expense of surface cooling. Some 53 per cent of the farms in the sample still used surface cooling in 1956–57, whilst 33 per cent practised in-churn cooling, seven per cent used refrigeration and the remaining seven per cent used churn-immersion methods.

Similarly, the use of approved hypochlorite solutions has become a more popular method of sterilizing the dairy utensils than using steam sterilizers. Table 3 compares the use of the different methods of sterilizing on the sample farms in 1956–57.

TABLE 3

Percentage Distribution of Herds between Methods of Sterilizing. 414 *farms* 1956–57

Method Used	per cent
Boiling Water	12
Steam	25
Approved Hypochlorite	37
,, ,, plus Boiling Water	16
,, ,, plus Steam	10
	100

One-quarter of the farmers relied upon steam sterilization alone whereas 37 per cent used only approved hypochlorite solutions. A further one-quarter of the farmers played safe by using two methods of sterilization; in most of those cases, hypochlorite was probably used regularly with boiling water or steam being used once a week or only during hot weather.

Types of Lighting and Power Used

Oil lamps were still used for lighting on one-quarter of the farms with less than 20 cows whereas only 10 per cent of the larger farms had no electric light in the cowsheds. Electricity was also the most common source of power for the milking machines, although a few farmers used internal combustion engines. The types of power used in food preparation reflected some interesting differences in feeding practices on large and small farms. Details are given in Table 4. On more than 70 per cent of the smaller farms, no power machinery was used in feed preparation compared with only 15 per cent of the large farms. This difference illustrates the extent to which the smaller farmers either relied upon purchased compounds, or perhaps on the milling and mixing facilities of neighbouring farmers.

TABLE 4

Types of Power Used in Food Preparation for Herds of Different Sizes

Size of Herd	Percentage Using:			
	Electricity	Tractors	Stationary Engine	No Power Machinery
Less than 20 cows	10	13	5	72
20–39 cows	35	18	6	41
40–59 cows	55	15	4	26
60 cows and over	65	16	4	15
All Herds	28	15	5	52

Capital Invested in Dairy Stock and Equipment

Estimates were made of the capital value of the cows, other dairy stock and dairy equipment on the farms studied. The figures shown in Table 5 are the averages of the opening and closing valuations of these items. The general basis of herd valuation was cost to the farmer, which was the purchase price in the case of animals bought in, or cost of production in the case of home-bred animals. The problem of herd valuation and depreciation is discussed in more detail in a later section of this report; meanwhile the figures in Table 5 give a general indication of the capital investment in dairy herds. Dairy equipment included milking machines, dairy utensils and other items of farm equipment used chiefly for the dairy herd. The figures did not include estimates of the capital invested in crop production for the dairy herd. Neither were estimates made of the investment of landlord's capital in dairy farms.

TABLE 5

Capital Invested in Dairy Stock and Equipment on Farms of Different Sizes, 1955–57

Size of Farm	Under 25 acres	25–49·9	50–99·9	100–149·9	150–199·9	200–299·9	300 and over	All Herds
No. of Herds	50	73	110	68	49	36	40	426
Av. Size of Herd	8·2	12·5	19·8	29·1	37·1	42·6	58·6	26·3
Av. Size of Farm (acres)	17	38	75	125	173	247	463	132
	£	£	£	£	£	£	£	£
Capital* per Farm	713	1,153	1,968	2,914	3,666	5,020	6,436	2,735
Capital* per Acre	42	30	26	23	21	20	14	21
Capital* per Cow in:	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
(i) Cows	61 9	60 5	62 10	61 9	59 16	68 6	62 2	62 17
(ii) Other Dairy Stock	17 16	23 10	29 1	31 10	32 18	42 15	41 3	34 1
(iii) Dairy Equipment	7 14	8 10	7 17	7 4	6 4	6 16	6 12	7 2
Total Capital* per Cow	86 19	92 5	99 8	100 3	98 18	117 17	109 17	104 0
Capital invested in other Dairy Stock as per cent of Cows	29·0	39·0	46·4	51·3	54·8	62·6	66·3	54·1
Capital invested in Dairy Equipment as per cent of Cows	12·5	14·1	12·5	11·7	10·4	9·9	10·6	11·3

*The figures refer to capital invested in dairy stock and equipment only.

On average the capital invested per cow was £104, ranging from £87 per cow on the small farms to £110–120 per cow on the larger farms. The difference in the total investment per cow was almost entirely due to the greater proportion of young stock on the larger farms. Economies of scale in the use of dairy equipment on the larger farms were not as great as might have been expected—presumably because the use of more elaborate and more modern equipment offset most of the savings achieved by greater use of the equipment. The total capital value of dairy cows, other dairy stock and dairy equipment ranged from £700 on the farms under 25 acres to more than £6,000 for farms above 300 acres.

II. MILK PRODUCTION COSTS AND RETURNS

This chapter presents some details of the costs of producing milk. But before examining the costs, it is necessary to consider some of the accounting methods used in the study, because interpretation of the cost figures depends upon clear understanding of the methods by which these costs were calculated.

Accounting Methods

The whole dairy enterprise, including followers, was the unit for costing purposes. Generally speaking, monthly records were completed by the co-operating farmers, showing the number of dairy cows and other dairy stock on the farm and the production and sales of milk during the month. The quantities and prices of purchased feedingstuffs consumed by the dairy herds were recorded, and estimates were also made of the quantities of home-grown foods fed to both the milking herds and the followers. Separate records were kept on each farm to determine the cost of producing home-grown foods, which were charged to the dairy herd at estimated costs of production.

Hours of labour spent with the dairy herds were recorded and hired labour was charged at cost to the farmer, whilst the farmer's own manual labour was charged at average hourly earnings for skilled stockmen. Records were also kept of the miscellaneous expenses incurred each month—such as repairs and renewals of equipment and veterinary expenses.

At the end of each costing year (30 September) annual production costs were calculated from the monthly record sheets. To the direct expenses of the milking herd were added computations of the herd replacement and depreciation costs. Details of the method of calculating these are given in a later chapter which discusses herd replacement policies on dairy farms (see page 38). The residual manurial values of feedingstuffs consumed were deducted from the gross costs of production to arrive at net production costs.

In calculating the returns from milk production, milk sold wholesale, retailed or fed to livestock was valued at wholesale prices. Milk sold to employees or used in the farmhouse was valued at the maximum rates prescribed by the Agricultural Wages Orders.

Since an estimate of the value of the manual work of the farmer and his family was included in the net costs of production, the margins between the costs and returns included the reward for the farmer's managerial skill and the interest earned on the capital invested for milk production. A number of the tables which follow show also the family incomes derived from dairying. Family income is the difference between costs and returns if no charge is made for the manual work of the farmer and unpaid members of his family. On some farms, particularly the smaller family farms employing little or no hired labour, it is a more realistic reflection of the farm profits obtained from dairying than is the margin between the net costs of production and returns.

Accounting Costs and Real Costs

The production costs calculated in this study may be termed "accounting costs" since they include both the direct expenses of growing fodder crops and keeping cows, and a proportion of the general overhead expenses of running a farm business. They represent that proportion of farm expenses which might fairly be charged against milk production in a detailed farm account. They should not be confused with the costs which are calculated in the preparation of farm budgets, which differ from the accounting costs in two respects. First, in the accounting costs all home-grown foods are charged to the dairy herd at the costs of production whereas, in preparing a budget, foods such as cereals with a ready market value would be charged to the dairy herd at their market values. This is because the sale price of the cereals, rather than their costs of production, might be regarded as the real costs of feeding the home-grown cereals to the dairy herd. Secondly, the only costs which are of interest in budgeting are those relating to specific decisions. For instance, the costs of adding one or two cows to a dairy herd will not normally affect the level of the general farm expenses which may therefore be ignored when budgeting the effect of the additional cows on farm profits. Therefore, the production costs quoted in this report should not be used for budgeting without suitable adjustments to the figures. It would be incorrect, for instance to assume that because the average cost of a home-bred heifer entering the dairy herds was about £72 then the average cost of rearing an additional heifer would also be £72. The additional costs would probably be lower because many of the expenses allocated to the followers would not increase if the number of heifers increased slightly.

Costs and Returns in 1955-56 and 1956-57

A summary of the costs, returns and margins for an identical sample of 366 herds in 1955–56 and 1956–57 is given in Table 6. Feed was the largest item of cost, accounting for some 60 per cent of the total production costs, followed by labour, which accounted for a further 20 per cent. Between the two years, the average net cost of production declined from £97 to £92 12*s*. per cow, mainly due to reduced expenditure on purchased foods. However, in the second year, although yields had increased slightly, the returns per cow were lower mainly because of the depressing effect on the pool prices of increasing quantities of milk which could only be sold for manufacturing. Consequently, the margin per cow fell from an average of £34 in 1955–56 to £29 9*s*. in 1956–57. Owing to increases in cow numbers, the margin per herd did not decline as greatly as the margin per cow. Nevertheless, there was a reduction of some £75—from £871 to £795—in the margin per herd between the two years.

Details of changes in average feed consumption between the two years are given in Table 7. In the earlier year, almost 3½ lb of concentrates were fed for each gallon of milk produced. But, partly resulting from the wet season and open winter of 1956–57 which favoured the growth of grass and fodder crops, the consumption of concentrates fell to 3 lb per gallon in the second year. Since the prices of purchased concentrates were almost unchanged between the years, it is apparent that the decline in milk production costs which was noted earlier may be attributed partly to the reduction in the consumption of concentrates. In addition the consumption of hay fell between the two years from 2·7 lb to 2 lb per gallon.

TABLE 6

Costs, Returns and Margins for an Identical Sample of Dairy Herds in 1955–56 *and* 1956–57

	1955–56	1956–57	1955–56	1956–57
No. of Herds	366	366	—	—
Av. No. of Cows per Herd	25·6	27·0	—	—
Av. Yield per Cow (gal)	806	815	—	—
Labour Hours per Cow	124	117	—	—
	per cow		per gallon	
	£ s.	£ s.	*d.*	*d.*
Costs				
Foods: Purchased	33 17	28 19	10·08	8·53
Home-grown	18 16	18 5	5·60	5·38
Grazing	9 2	9 0	2·71	2·65
Total	61 15	56 4	18·39	16·56
Labour	20 16	20 15	6·19	6·11
Miscellaneous	14 12	14 9	4·34	4·25
Herd Replacement	2 4	3 5	0·66	0·95
Gross Farm Costs	99 7	94 13	29·58	27·87
Credit: Manurial residues	2 6	2 1	0·68	0·60
Net Farm Costs	97 1	92 12	28·90	27·27
Returns	131 1	122 1	39·02	35·94
Margins	34 0	29 9	10·12	8·67
Family Income	41 12	37 3	12·38	10·94
	£	£		
Net Costs per Herd	2,484	2,500	—	—
Returns per Herd	3,355	3,295	—	—
Margin per Herd	871	795		

Table 7 also shows, for all the farms in the survey, the average quantities of home-grown foods fed in each of the two years. Further analysis of the farms using different types of feed led to the general conclusion that on the farms in the study where hay was fed, from 15 cwt to one ton per cow was a typical amount fed. Similarly, on farms using roots and green fodder and silage, averages of some 2¾–3½ tons of roots and green fodder and 2¼–2½ tons on silage per head were fed. The utilization of grazing, as calculated by the residual method, was at the rate of 14–15 cwt of starch equivalent per cow.

TABLE 7

Quantities of Foods Fed and Cost per Cwt 1955–56 *and* 1956–57

	Average Quantities Fed				Avge Cost per Cwt	
	1955–56	1956–57	1955–56	19565–7	1955–56	1956–57
	cwt per cow		*lb per gal*		*s. d.*	*s. d.*
Concentrates: Purchased	18·6	16·3	2·6	2·2	34 6	34 4
Home-grown	5·7	5·1	0·8	0·7	14 5	16 5
Dried Grass	0·7	0·7	0·1	0·1	20 5	20 8
Total Concentrates	25·0	22·1	3·5	3·0	—	—
Hay	19·2	14·8	2·7	2·0	6 10	7 7
Straw	1·6	1·4	0·2	0·2	3 6	3 5
Roots and Green Fodder	45·0	55·6	6·3	7·6	1 11	1 8
Wet Grains	1·1	0·8	0·1	0·1	3 4	4 0
Silage	30·7	28·4	4·3	3·9	2 6	2 9
Other Foods	0·2	0·2	0·0	0·0	—	—
Grazing (SE)*	13·9	15·3	1·9	2·1	—	—

*The utilization of starch equivalent from grazing was calculated as the residual feed requirement after deducting the starch equivalent value of other foods from the total theoretical feed requirements.

Range of Production Costs

In the introduction, attention was drawn to the fact that average figures obtained from farm surveys invariably lie within wide extremes for individual farms because of the diverse conditions in which milk production is carried on, the wide variations from farm to farm in the amounts and kinds of resources available, and the varying efficiency with which the resources are used. This study was no exception. Table 8 and Fig. 1 show the variations in production costs from farm to farm in 1955–56 and 1956–57. Costs in both years ranged from less than 1*s*. 4*d*. per gallon to more than 3*s*. per gallon, although rather more than 50 per cent of the milk was produced at between 2*s*. and 2*s*. 8*d*. per gallon. It is interesting to note that the proportion of herds in the high-cost group was higher than the proportion of milk production. It follows that either the high-cost herds tended to be smaller than the low-costs herds or that yields were much lower on the high-cost herds. The effects of herd size on the profitability of milk production are examined in Chapter III.

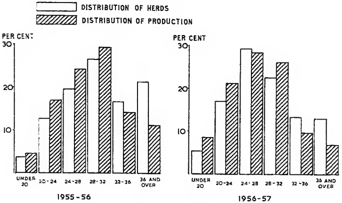

FIG. 1 *Variations in the Net Farm Cost (pence per gallon)*

TABLE 8

Ranges of Net Farm Costs per Gallon, 1955–56 and 1956–57

	1955–56		1956–57	
No. of Farms	438		414	
Av. Net Farm Costs per Gallon	29·0*d.*		27·17*d.*	
Net Farm Cost (pence per gallon)	Distribution of Herds	Distribution of Production	Distribution of Herds	Distribution of Production
	per cent	per cent	per cent	per cent
Under 20	3·9	4·6	5·3	8·2
20–23·9	12·8	16·5	16·9	21·6
24–27·9	19·6	23·9	29·0	27·9
28–31·9	26·3	29·4	22·7	26·4
32–35·9	16·4	14·4	13·3	9·6
36 and over	21·0	11·2	12·8	6·3
	100·0	100·0	100·0	100·0

Changes in Production Costs Since 1951-52

One hundred and forty-five farmers who co-operated in the study had also taken part in a similar investigation in 1951–52. In the Table 9 the average results achieved on this sample of farms in 1951–52 are compared with the costs and returns on the same farms in 1955–56 and 1956–57. During that period, there was an increase of four cows—15 per cent—in the average size of herd on the sample farms; this increase was greater than the increase in the average size of dairy herds in the country as a whole. Milk yields also increased by 11 per cent from 718 gallons to 798 gallons per cow. There was a substantial reduction in the labour used per cow. Over the five-year period, the average number of hours worked per cow declined by more than 20 per cent, from 141 hours to 112 hours. There was also a change in the method of calculating herd replacement costs (see footnote to Table 9) which increased those costs.

The effects of all these changes are shown in the figures of costs and returns. There was a considerable increase in the costs of purchased feedingstuffs per cow during the period—a reflection of both increased consumption following the decontrol of feedingstuffs and the higher prices of the later years. On the other hand, there was a smaller proportionate increase in labour costs. In fact, labour costs per gallon of milk produced actually declined between 1951–52 and 1956–57 notwithstanding that average earnings of agricultural workers increased by 39 per cent during that period. Nevertheless, total production costs per cow increased by £12 to £16 per cow whereas returns increased by only £7 to £15 per cow. Consequently, the margin declined by up to £5 per cow.

The extent to which these changes were offset by the larger sizes of herds is shown by the average margin per herd in each of the three years. The margin per herd in 1956–57 was virtually the same as the margin obtained in 1951–52. Thus in the face of considerable increases in the cost of materials and labour, due to the inflationary conditions, and some decrease in the return for milk the farmers in the investigation had taken, in general, active steps to improve their production methods to offset these changes and to maintain their incomes.

The figures illustrate the dangers of assessing the effects on farm profits of cost changes over a period of time unless some account can also be taken of the gradual but continuous changes which are taking place in farming practices. At the rate of usage in 1951–52 the cost of the resources used in milk production probably increased by *4d.* to *5d.* per gallon from 1952 to 1957 whilst returns per gallon went down by 1½*d.* But the actual production costs per gallon did not increase by that amount because farmers adapted their production methods, presumably as a result of the price changes which occurred. Consequently, the average margin per herd in 1956–57 was virtually maintained at the 1951–52 level.

Adjusted Estimates of Average Production Costs

This section deals with some of the problems associated with the preparation of average figures from the results obtained from individual farms. The average figures which have been quoted in previous tables were obtained by dividing the total production costs for all the herds in the sample by either the

TABLE 9

Costs, Returns and Margins for an Identical Sample of 145 *Herds*, 1951–52, 1955–56 *and* 1956–57

	1951–52	1955–56	1956–57
No. of Herds	145	145	145
Average Size of Farm (ac)	134	140	143
Average Size of Herd	25	27	29
Average Yield per Cow (gal)	718	781	798
Labour Hours per Cow	141	120	112

	Per Cow			Per Gallon		
	1951–52	1955–56	1956–57	1951–52	1955–56	1956–57
	£ s.	£ s.	£ s.	*d.*	*d.*	*d.*
Purchased Foods	21 7	31 15	27 1	7·1	9·8	8·1
Home Grown Foods	19 2	18 5	19 2	6·4	5·6	5·7
Grazing	6 6	8 19	8 14	2·1	2·7	2·6
Total Foods	46 15	58 19	54 17	15·6	18·1	16·5
Labour	17 18	20 0	19 13	6·0	6·1	5·9
Miscellaneous	12 2	13 15	13 12	4·0	4·2	4·1
Herd Replacement	13	2 9	2 9	0·2	0·8	0·7
Gross Farm Costs	77 8	95 3	90 11	25·9	29·2	27·2
Manurial Residues	1 4	2 10	2 3	0·40	0·7	0·6
Net Farm Costs	76 4	92 13	88 8	25·5	28·5	26·6
Returns	111 8	126 12	118 12	37·2	38·9	35·7
Margins	35 4	33 19	30 4	11·8	10·4	9·1
Family Income	41 8	40 11	37 8	13·8	12·4	11·2
	£	£	£			
Net Costs per Herd	1,875	2,531	2,515	—	—	—
Returns per Herd	2,740	3,458	3,373	—	—	—
Margin per Herd	865	927	858	—	—	—

Note: There was a change in the method of calculating herd replacements between 1951–52 and 1955–56. In 1951–52 home-bred heifers were brought into the berd at estimated commercial values. In 1955–56 and 1956–57 heifers were costed on all these farms and transfers were brought in at their cost of production up to the time of calving.

total number of cows in the sample or the total gallonage of milk produced on the sample farms. But, as pointed out in Chapter I, there were proportionately more large herds in the sample than there were in the national dairy herd, and this method of calculating average costs makes no allowance for the size distribution of the national herd. Such an allowance can be made, however, by weighting the total costs of each herd-size group in the sample by the national number of dairy cows in each group. The results of a calculation of this kind are shown in Table 10. The adjusted average net farm costs per cow were estimated to be £1 15*s.* and £1 3*s.* per cow higher than the averages of the sample farms in 1955–56 and 1956–57 respectively. The difference in the average net farm costs per gallon were, however, proportionately greater—the adjusted costs being 1·0*d.* per gallon and 0·8*d.* per gallon more in 1955–56 and 1956–57 respectively. This was due to the lower average yields per cow which were obtained when the results for each herd size group in the sample were weighted by the national number of dairy cows in each group. The adjusted average returns and margins were also affected by the lower average yields per cow—the margins being £2 17*s.* per cow less in 1955–56 and £2 15*s.* less in 1956–57. On the other hand, the family incomes per cow were greater in the adjusted results for both years.

TABLE 10

Results for the Sample Farms Adjusted to Reflect the Size Distribution of the National Herd, 1955–56 *and* 1956–57

	Per Cow				Per Gallon			
	Adjusted Results		Sample Results*		Adjusted Results		Sample Results *	
	1955–56	1956–57	1955–56	1956–57	1955–56	1956–57	1955–56	1956–57
	£ s.	£ s.	£ s.	£ s.	*d.*	*d.*	*d.*	*d.*
Purchased Foods	34 11	30 0	33 16	29 8	10·48	8·92	10·10	8·59
Home-grown Foods	18 2	17 13	18 12	18 5	5·49	5·25	5·56	5·34
Grazing	9 3	9 1	9 2	9 1	2·78	2·69	2·72	2·65
Total Foods	61 16	56 14	61 10	56 14	18 75	16·86	18·38	16·58
Labour	22 3	21 18	20 16	20 16	6·72	6·51	6·21	6·08
Other Costs	14 18	15 10	14 16	15 9	4·52	4·61	4·42	4·51
Total Costs	98 17	94 2	97 2	92 19	29·99	27·98	29·01	27·17
Returns	129 19	121 8	130 11	123 0	39·43	36·10	39·01	35·96
Margins	31 2	27 6	33 9	30 1	9·44	8·12	10·00	8·79
Family Income	42 3	38 9	40 14	37 18	12·79	11·43	12·17	11·08
Av. Yield per Cow (gal)	791	807	803	821				

*The figures in these columns refer to the total sample of farms and therefore they differ slightly from the figure in Table 6 which referred to an identical sample.

Even these adjusted figures cannot be regarded as precise measures of national average production costs. The reasons for this have already been given in Chapter I—the sample may or may not adequately reflect the different systems of dairying in the country, and the farmers who co-operated in the study may or may not be representative of all dairy farmers. Although it is impossible to determine statistically just how closely the sample reflects the national position as regards levels of costs and returns, the results give valuable indications of the directions in which costs and returns generally have been moving. At the same time the differences in production methods and profit margins on individual farms within the sample do demonstrate how much more successful some dairy farmers are than others in producing milk profitably. Elucidation of the reasons for these differences in individual farm achievements is one of the primary purposes of this study. Various methods of profitable milk production are examined in detail in later chapters.

Primary Costs of Milk Production

The figures given in the previous tables showed that feed accounted for some 60 per cent of the total production costs, and labour accounted for a further 20 per cent. But the costs of the home-grown feeds consists of labour, fertilizers, tractor fuel and repairs, and so on. If these costs are allocated to the different resources which farmers buy, then the magnitude of the different types of farm expenses, or the basic farming inputs, is demonstrated. These expenses may be termed the "primary costs" of milk production, and their relative importance is shown in Table 11. Manual labour was shown to account for 33 per cent of milk production costs and purchased foods for a further 29 per cent. Thus, manual labour—both directly concerned with milking and feeding the cows and engaged in producing feed for the dairy herd —represented one third of the total costs of producing milk. There were, of course, considerable variations in labour requirements from farm to farm, and this subject is discussed in Chapter III.

TABLE 11
Primary Costs of Milk Production 1955-57

	per cent
Manual Labour	33·2
Contract Services	1·3
Rent	7·9
Purchased Fertilizers	7·2
Purchased Foods	29·3
Seeds	1·1
Machinery Depreciation and Repairs	8·0
Fuel and Oil	2·9
Miscellaneous	9·1
	100·0

III. VARIATIONS IN PRODUCTION COSTS AND RETURNS

Some of the farmers in the study produced milk at a cost of less than 1*s*. 8*d*. per gallon: others at a cost of more than 3*s*. per gallon. Some of the reasons for these variations are discussed in this chapter, and later chapters describe ways in which the level of efficiency of milk production might be improved.

Size of Herd

Milk production is the backbone of a great many small farm businesses and the farmers concerned depend upon it for a substantial part of their livelihood. For many of them any alternatives to milk production—for instance, beef cattle or sheep—are limited because of the restricted acreages of their farms. Nevertheless, they have to compete with larger-scale farmers who are in a better position to achieve economies of scale in milk production, and who at the same time are better able to switch to other forms of production if that seems desirable.

TABLE 12

Costs, Returns and Margins for Herds of Different Sizes, Identical Sample, 1955–57

Size of Herd	0–9·9	10–19·9	20–29·9	30–39·9	40–49·9	50–59·9	60 and over	All Herds
No. of Herds	57	115	78	41	35	14	26	366
Av. Size of Herd	7·3	14·7	24·4	34·5	44·5	54·8	71·7	26·3
Av. Yield per Cow (gal)	767	778	815	792	820	806	852	811
Labour Hours per Cow	194	135	131	110	105	97	111	121
Percentage Unpaid Labour	90·4	66·2	42·9	28·0	17·9	15·2	9·3	37·1
	Cwt. Utilized SE per Cow							
Purchased Concentrates	11·5	11·2	10·1	8·9	10·2	13·0	10·9	10·7
Home-grown Concentrates	1·1	2·1	2·8	3·4	4·1	3·2	4·5	3·2
Total Concentrates	12·6	13·3	12·9	12·3	14·3	16·2	15·4	13·9
Roots and Green Fodder	2·9	2·8	3·5	3·9	3·9	3·7	4·0	3·5
Silage	0·7	2·2	2·9	3·8	3·6	4·6	4·0	3·3
Hay and Straw	8·7	6·5	6·2	4·8	5·0	6·0	4·7	5·6
Grazing* and Other Foods	13·9	14·3	14·6	14·9	13·4	9·3	12·9	13·7
Total	38·8	39·1	40·1	39·4	40·2	39·8	41·0	40·0
	Per Cow							
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Total Food Costs	61 7	59 8	59 3	53 14	59 19	61 6	60 7	59 0
Total Labour Costs	32 12	22 7	21 16	18 12	18 17	17 4	20 9	20 15
Other Costs	19 7	14 16	15 9	13 6	14 1	16 1	15 13	15 1
Total Costs	113 6	96 11	96 8	85 12	92 17	94 11	96 9	94 16
Returns	120 8	123 2	127 8	123 6	127 15	125 11	132 5	126 11
Margin	7 2	26 11	31 0	37 14	34 18	31 0	35 16	31 15
Family Income† per Cow	37 4	41 17	40 8	42 9	38 5	33 13	37 13	39 8
Family Income per Gallon	11·6*d.*	12·9*d.*	11·9*d.*	12·9*d.*	11·2*d.*	10·0*d.*	10·6*d.*	11·7*d.*
Family Income per Herd	£272	£615	£986	£1,465	£1,702	£1,844	£2,700	£1,036

*The utilization of starch equivalent from grazing was calculated as the residual feed requirement after deducting the starch equivalent value of other foods from total theoretical feed requirements.

†Family income is the difference between costs and returns if no charge is made for the manual work of the farmer and unpaid members of his family.

Table 12 gives some comparisons between the costs, returns and margins of smaller and larger herds in the study. There appeared to be several distinctions between the herds above and below 20 cows in size. Generally the smaller herds obtained lower yields; the amount of manual labour used per cow was greater, particularly in the vary small herds, but it included a much higher proportion of unpaid family labour. With regard to feeding, smaller farmers purchased a greater proportion of the feed used by the dairy herd. Also, they used considerably less silage and roots per cow, but relied on hay to a greater extent than did the larger-scale farmers. The utilization of grazing per cow was at approximately the same level for all sizes of herd, although, as pointed out with reference to Table 2, the density of stocking was greater on the smaller farms. Therefore, the utilization of starch equivalent per acre from grazing must have been greater on the smaller farms.

The economic consequences of these differences are also shown in the table. Higher expenditure on purchased concentrates for the smaller herds was offset by lower use of home-grown feed so that total feed costs did not vary significantly with size of herd. The labour use per cow was also significantly higher in the smaller herds. Since there was little hired labour on the small farms, however, the high labour charges did not represent large cash expenses because in most cases, the charges were the imputed value of family labour. At the same time it is possible that the productive work done per cow in the small herds was not as high as the reported figures of the time spent with the herds. If the smaller farmers fully appreciated the earning capacity of their own labour, it is likely that they would use some of the many hours spent looking after the cows on additional enterprises or activities where their labour would be more productive.

The margins of returns over costs per cow were substantially lower on the smaller herds; but the family income per cow, i.e., the income earned by the farmer and his family, was not very different from the average family income per cow for all sizes of herd. Similarly, the family income per gallon for the smallest herds was close to the average family income of 1*s*. per gallon for herds of all sizes. But the family income on the smaller farms was mainly a return to manual labour whereas the family income on a larger farm was to a much larger extent a return to managerial labour and capital. These results suggest that although there were several differences in production methods in large and small herds, there was no evidence that the small-scale farmers were unable to compete successfully in milk production with their larger-scale competitors. Indeed, if the smaller farmers were able to utilize their labour to better advantage they would probably show up to advantage in comparison with the larger farmers, especially when it is recalled that home-grown feeds were charged at cost of production and the family income per cow on the larger herds represented the profit on the fodder crops grown for the cows as well as the profit on milk production itself. Of course, the family income per herd was much smaller for the smaller herds—but this is a consequence of the size of business, not of the efficiency of production. It may be concluded from this study, therefore, that the relatively low incomes of the smaller dairy farmers were due more to their small scale of business than to any relative inefficiencies in their methods of milk production.

Seasonality of Production

In recent years there have been some changes of emphasis in the seasonal pattern of prices paid to milk producers, presumably with a view to increasing the relative profitability of milk produced in the summer months (April–September) in relation to milk produced in the winter months (October–March) and thereby inducing a shift in the seasonal pattern of milk production. It may be seen from Fig. 2 that from 1950–52 to 1955–57 prices paid for summer milk increased relatively to the prices paid for winter milk.

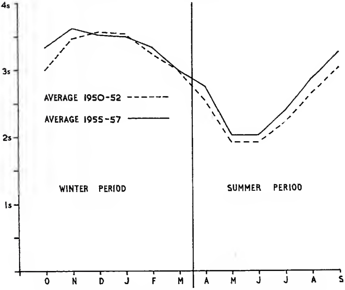

FIG. 2. *Seasonal Pattern of Milk Prices.* 1950–52 *and* 1955–57

Source: Regional Pool Prices per Gallon, ordinary milk. North Western Region

Although the monthly prices paid fluctuate from year to year according to changes in the quantity of milk produced nationally, the tendency towards lower winter prices has persisted for a number of years.

There was little conclusive evidence from the results of the investigation about the relative profitability of concentrating on the production of either winter or summer milk. Profit margins increased as the proportion of winter milk increased to about 55 per cent of annual production and margins then decreased as the proportion of winter milk increased still further. But the variations in the average profit margins were not likely to be due solely to the seasonality of production. This factor is only one of the many management decisions which combine together to determine the profitability of production.

The contribution of grazing to the feeding of the dairy herd was highest on the farms which concentrated on summer milk production. Indeed, the choice between winter and summer milk production depends to some extent upon the amount of milk which can be obtained from grazing and the length of the grazing season. If a farmer with a limited acreage is able to provide little more than a maintenance ration from grazing then it is probably profitable for him to concentrate on winter production when the higher milk prices compensate him for the higher costs of feeding concentrates or other hand-fed feeds. On the other hand, farmers who are able to obtain a substantial part of the production rations from grazing, which can be the cheapest source of nutriment for dairy cows, might well have higher margins over feed costs during the summer when the prices for milk are much lower than in winter. The most profitable alternative therefore depends upon the circumstances of individual farms and cannot be determined satisfactorily from an examination of the variations in costs and returns from a sample of farms.

Yields and Feeding Practices

One of the most difficult problems facing dairy farmers is to know how much feed to give their dairy cows and what levels of yields to aim at. As pointed out earlier in this report, the cost of feed is some 60 per cent of the total production costs. It is evident that any economies in the use of feed would improve the profitability of milk production. But yields can be affected substantially by levels of feeding; and it is therefore frequently a moot point whether profits would be increased by feeding at higher levels to obtain higher yields or by feeding at lower levels and accepting somewhat lower yields.

The problem will not be satisfactorily solved until more is known about the feed requirements of dairy cows. Conventional feeding standards assume a constant relationship between the amount of feed used and the quantity of milk produced. It is now widely accepted that these standards do not adequately reflect the response of the dairy cow to different levels of feeding, which are subject to diminishing returns.* But farmers have little other than their past experience to help them determine whether the cost of additional feed would be covered by the value of additional milk produced. The problem is further complicated by the many different combinations of feedingstuffs which may be fed. When the problem is so wide and the scientific information so limited, it was to be expected that many different feeding practices and levels of yield would be found on the farms in the study. Some successful farmers incurred high feed costs in obtaining high yields; other equally successful farmers managed their herds profitably at average yields and low feed costs. Conversely, there were instances of relatively low profits from dairy herds associated with both high feed costs and low feed costs. It may be presumed that the successful farmers were pursuing definite policies. The successful high-cost producers were satisfied that high yields were essential if reasonable profits were to be obtained: the low-cost producers were probably equally satisfied that yields must be kept at a sufficiently high level in relation to feed costs. The unsuccessful farmers probably fell between two stools, i.e., they either fed for high yields but did not obtain them, or they expected their cows to yield at average levels of production on inadequate rations.

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*The need for more accurate knowledge of the food requirements of livestock was emphasized in the Report of the Committee on Grassland Utilization (Cmnd. 547), and in a paper on "Feeding Standards for Livestock" read by Dr. K. L. Blaxter to The Farmers' Club on 11th February, 1959.

To a large extent, the variation in costs, returns and margins from milk production are associated with differences in feeding practices and yields obtained. A comparison of the results for herds grouped at different levels of yield is shown in Table 13. As noted from a previous table, the lower-yield herds tended to be rather smaller than average, with consequently higher figures of labour usage. As might be expected, a greater proportion of the milk from the low-yielding herds was produced in the summer months; however, there were no significant differences in the density of stocking for the different yield groups. With the exception of the lowest-yielding group where the low margin per gallon was largely the result of higher labour inputs, there was a steady increase in margins per gallon as yields increased. The family income per gallon was almost constant at about 1*s.* per gallon for all the yield groups with more than 640 gallons. Although average costs per cow increased constantly and substantially with increasing yields, there were more than proportionate increases in returns, with consequent improvements in both the margin per cow and family income per cow.

TABLE 13

Comparison of Results obtained from Herds in Different Yield Groups. Identical Sample. 1955–57

Gal per Cow per Annum	Under 550 gals	550 to	640 to	730 to	820 to	910 to	1,000 and over	All herds
No. of Herds	19	42	73	81	72	40	39	366
Av. Size of Herd	16·0	23·4	25·4	28·4	27·1	26·5	38·0	26·3
Av. Yield per Cow (gal)	475	606	692	782	863	955	1,094	811
Seasonality (% milk produced in winter months)	44·9	46·8	45·8	47·7	48·5	48·8	50·4	48·0
Labour Hours per Cow	126	117	114	113	122	124	144	121
Livestock Acres per Cow	3·0	3·1	3·1	2·9	3·0	2·9	3·2	3·0
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	
Margin per gallon	2·8	7·2	9·1	9·7	9·5	10·1	10·4	9·4
Family income per gallon	9·8	10·2	11·9	11·9	11·8	12·4	11·4	11·7
	£ *s.*	£ *s.*	£ *s.*	£ *s.*	£ *s.*	£ *s.*	£ *s.*	£ *s.*
Total Costs per Cow	71 11	79 19	83 2	89 10	99 4	107 10	122 11	94 16
Returns per Cow	77 3	98 3	109 8	121 2	133 9	147 17	169 15	126 11
Margin per Cow	5 12	18 4	26 6	31 12	34 5	40 7	47 4	31 15
Family Income per Cow	18 16	25 15	34 8	38 16	42 10	49 3	51 18	39 8

Consumption of Feed

The higher yields were naturally associated with increased feed consumption. Larger quantities of concentrates and other types of feed, especially roots, green fodder and silage were consumed by the higher yielding cows. In terms of starch-equivalent, total hand-fed foods ranged from 16·9 cwt for cows with an average yield of 482 gallons to 36 cwt S.E. for cows yielding an average of 1,090 gallons. These feed quantities compare with the total conventional requirements of 31·1 cwt S.E. and 47·5 cwt S.E. for the two groups respectively. The starch equivalent derived from grazing, estimated at 14·2 cwt and 11·5 cwt respectively, was calculated as the difference between the conventional theoretical requirements and the quantity supplied by other feeds. It must be remembered, however, that this method of calculation implies that no over-feeding of hand-fed foods took place and that the feed requirements of the cows were proportionate to the yields obtained. In practice, of course, the cows may have consumed considerably more grass than the figures suggest, and the higher yielding cows may in fact have consumed more grass than the lower yielding cows.

Although the results of the study showed that, in general, higher yields were associated with higher than average margins, and that increased concentrate consumption was associated with higher yields, it does not follow that increasing the use of concentrates will invariably lead to more profitable production. Table 14 shows the average costs, returns and margins per cow at different levels of consumption of concentrates. There was no indication that feeding more than 10–14 cwt of concentrates per cow had any beneficial effect on total profitability of production, since the average profits at this level of feeding were just as high as, or higher than, the profits associated with higher levels of feeding and higher average yields. In this respect, the cost of the concentrates consumed in relation to the returns from the extra milk produced is critical. Large quantities of feed are required in order to obtain high yields. If these feeds can be supplied relatively cheaply and used effectively, then high yields can be profitable. For instance, increased feeding of home-grown concentrates was associated with increased margins per cow. This was

TABLE 14

Concentrates and Margins per Cow, 1955–57

Concentrates Fed per Cow	No. of Herds	Average Yield per Cow	Per Cow					
			Costs		Returns		Margins	
cwt		*gal*	£	*s.*	£	*s.*	£	*s.*
0–4·9	8	607	65	4	93	4	28	0
5–9·9	24	642	71	17	100	13	28	16
10–14·9	68	714	77	13	111	4	33	11
15–19·9	94	752	86	10	117	9	30	19
20–24·9	91	817	94	11	127	4	32	13
25–29·9	61	831	99	8	129	13	30	5
30–34·9	36	942	114	3	147	8	33	5
35–39·9	22	969	121	15	149	18	28	3
40 over	22	1,045	128	16	162	13	33	17
All Herds	426	812	95	1	126	16	31	15

probably due to the home-grown concentrates being charged to the herds at cost of production so that the margins obtained by feeding them included the profits on producing the crops as well as on milking the cows. But the results suggested that in circumstances where feed costs can be kept low in relation to yields then high yields are profitable. On the other hand, if the feeds required for high yields are relatively expensive then striving for high yields may not be a profitable business.

It may be concluded from this section on yields and feeding practices that to a large extent the variations in costs, returns and margins from milk production are closely associated with differences in feeding practices and yields obtained. The profit margin of the dairy herd depends upon neither the level of returns from milk nor the total feed costs but upon the difference between them. A wide range of yields and of feed costs can be profitable, provided that the feed costs and the yields linked with them are at appropriate levels. High yields or low costs are of themselves no guarantee of profitable production, for high yields obtained with high feed costs will be as unprofitable as low feed costs which produce only low yields. Comparisons of alternative feeding systems are further examined in Chapter IV.

Labour Use

There was a wide range in recorded amounts of labour used for the dairy herds. The range, in labour hours per cow, is shown in Table 15. In some herds less than 100 hours per cow were used annually whilst in other herds more than 260 hours—or 32 days of eight hours each—were spent each year in looking after one cow. Again it may be seen that high labour use was associated with the smaller herds and that both margins and family income per cow declined as the amount of labour used increased. It is worth noting however, that on farms where the margin per cow was either negative or negligible because of high labour use, there was still an average return to family labour at the rate of £29 per cow. Indeed, the family income per cow on farms which

TABLE 15

Variations in Labour Used per Cow, 1955–57

Labour Hours per Cow	99·9 and under	100–139·9	140–179·9	180–219·9	220–259·9	260 and over	All Herds
No. of Herds	92	174	97	34	17	12	426
Av. Size of Herd	36·4	29·3	20·1	14·6	10·5	9·4	26·3
Av. Yield per Cow (gal)	766	823	843	870	866	863	812
Labour Hours per Cow	83	117	156	195	235	296	121
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Per Cow:							
Total Labour Costs	14 13	20 8	25 17	32 17	40 12	49 9	20 16
Total Costs	81 0	95 15	104 10	118 17	133 13	145 14	95 1
Returns	118 12	128 4	132 4	137 5	136 2	140 3	126 16
Margins	37 12	32 9	27 14	18 8	2 9	−5 11	31 15
Family Income	41 14	38 14	38 14	35 14	30 4	28 18	39 6

employed little or no hired labour compared favourably with the family income per cow obtained from herds looked after mainly by hired labour, as shown in Table 16. Family incomes of £45–48 per cow were typical of the herds where little hired labour was employed, whereas family incomes of £35–40 per cow were common when most of the work was done by hired labour. Net income per cow however, whether measured as family income or margin, expresses a rate of earnings only. This needs to be related with scale of operation (or size of herd) and the family income per herd was much smaller when little or no hired labour was employed because of smaller average size of the herd in such cases. It was perhaps surprising that milk yields per cow were higher where hired labour rather than family labour looked after the cows. These results may appear to cast doubt on the adage "one eye of the master's sees more than ten of the servants'"; but it is probable that the standard of management generally was higher for the larger herds where hired labour was employed, and where the margins per cow were also greater.

TABLE 16

Variations in the Proportion of Hired Labour Used in Dairy Herds, 1955–57

Percentage of Unpaid Family Labour	All Hired Labour	1– 19·9%	20– 39·9%	40– 59·9%	60– 79·9%	80– 99·9%	100% Family Labour	All Groups
No. of Herds	77	47	56	56	38	33	119	426
Av. Size of Herd	44·0	36·0	33·7	26·8	19·0	15·8	12·3	26·3
Av. Yield per Cow (gal)	858	817	795	795	767	790	768	812
Av. Size of Farm (acres)	283	190	139	121	86	70	48	132
Labour Hours per Cow	116	113	111	123	136	142	140	121
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Total Costs Per Cow	99 15	92 14	89 14	93 3	89 18	97 2	97 6	95 1
Returns per Cow	133 17	128 18	123 11	123 5	120 0	124 4	119 17	126 16
Margins per Cow	34 2	36 4	33 17	30 2	30 2	27 2	22 11	31 15
Family Income per Cow	34 2	37 18	39 13	39 16	45 1	48 4	46 4	39 6
Family Income per Herd	£1,500	£1,364	£1,673	£1,067	£856	£761	£568	£1,034

The results presented in this section suggest that the variations in the amount of labour used per cow were one of the important reasons for the variations in the profitability of milk production. The conclusion may be drawn that substantial economies in the use of labour are possible on many dairy farms. Methods of achieving such economies are discussed in Chapter V.

Miscellaneous Expenses and Herd Depreciation Costs

These two items together accounted for some 20 per cent of the costs of milk production. Miscellaneous expenses included such things as milking machine expenses, veterinary fees and medicines, artificial insemination and a share of general farm expenses, and averaged some £15 per cow. There was some variation in these expenses from farm to farm; attention to detail and the avoidance of unnecessary expenses can keep these costs to the minimum. But, in general, any reductions in these miscellaneous expenses are unlikely to affect the profitability of dairying to any great extent. There are some opportunities for economy in the use of these items, but on most farms there are much greater opportunities to improve profits by economies in the use of labour and feedingstuffs.

The average depreciation cost* per cow was not high—some £2 14*s.* 0*d.*, or only 2·8 per cent of the total production costs. There arose, however, two points of interest. First, there was a wide range in the depreciation costs per cow, as shown in Table 17.

TABLE 17

Range in Depreciation Costs per Cow. Identical Sample, 1955–57

		No. of Herds
Appreciation per Cow	+£4 and over	44
	Less than +£4	77
Depreciation per Cow	Less than −£4	113
	−£4 to −£7·9	70
	−£8 to −£11·9	33
	−£12 and over	29
Total		366

Some farmers were able to show an appreciation in the value of their herds. They achieved this partly by having relatively disease-free herds so that there were few sales of low-priced culls. They also offset any decline in the value of individual animals by selling some cows at a relatively high price or by obtaining good prices from the sale of calves, particularly those calves sired by a beef bull. Secondly, the relative advantages of rearing or purchasing replacements were not fully revealed by the herd depreciation costs. Rearing home-bred heifers may be a cheaper method of obtaining replacements for the dairy herd than the purchase of down-calving heifers. But, it must be remembered, any land and other resources used for heifer rearing could be used for further milk production on many farms. The alternative value of those resources used in heifer rearing is not reflected in the figures of the cost of rearing replacements. Consequently, an examination of the figures themselves does not throw much light on the most profitable method of obtaining herd replacements. The relative profitability of different herd replacement policies will be considered in detail in Chapter VI, where it will be demonstrated that the herd replacement policy adopted on an individual farm can have a much greater effect on the profitability of milk production than is suggested by a simple examination of the costs of herd depreciation.

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*Details of the calculation of the depreciation cost are given on page 40

IV. FEED ECONOMY

A major problem for the farmer is to decide upon the relative profitability of different feeding practices. A wide choice is open to him from the one extreme of feeding large quantities of concentrates and regarding his grassland as little more than an exercise ground for his cows to the other extreme of depending entirely on grassland products and forage crops for both the maintenance and production rations. In other words the choice extends from complete self sufficiency to complete dependence on purchased feeds. It has already been shown that differences in feeding practices and yields obtained are a major cause of the variations in production costs and the level of profits obtained.

It might appear, therefore, to be a relatively simple task to establish from the results of the large-scale investigation which of the alternative feeding systems were the most profitable, but any analysis is confused by two difficulties. First, conditions on individual farms vary so much that profitable feeding practices on one farm might be entirely unsuitable to the conditions on another farm. Consequently, poor results from particular feeding practices on a farm might be due to the circumstances of that farm rather than to any inherent weakness in the feeding system. The second, and more important difficulty, is that variations in the efficiency of management are as great or greater than the variations in the physical conditions of farms. Most systems of feeding can be made profitable by an efficient manager. Conversely, an inefficient stockman or dairy farmer will obtain poor results even from a feeding system ideally suited to the circumstances of his farm. Notwithstanding these difficulties, however, the study yielded some useful indications of the relative profitability of different feeding systems.

Cost of Food

There is a wide variety of alternative feedingstuffs available for dairy cows. Cereals, oil cakes, roots, green fodder and grass in varying forms are all widely employed. During the investigation, information was obtained from the co-operating farmers on the costs of producing the various home-grown foods. But since the nutritive content of feeds varies greatly, any comparison of costs must take into account their relative feeding value. This has been done in Table 18 by showing the costs of producing a ton of starch equivalent from each of the main feed crops produced on the farms in the sample. The cost of starch equivalent obtained from dairy cake is also shown in the table.

Grass grazed was by far the cheapest form of nutriment, followed by grazed kale. Root crops were shown to be a relatively expensive form of winter feed compared with cereals and grass products; but all the sources of home-produced feed appeared to be cheaper, on average, than purchased dairy cake.

The calculation of the cost of starch equivalent from grazing probably over-stated the real cost per ton. As explained earlier, the starch equivalent

TABLE 18

*Estimated Average Costs of Production of Starch Equivalent for Various Crops in 1956–57**

	Cost per ton of Starch Equivalent
	£
Grazing	12·6
Meadow Hay—in stack	21·8
Grass Silage—in clamp or pit	23·0
Dried Grass	39·8
Kale—grazed	17·6
Turnips and Swedes	34·6
Mangolds	36·6
Arable Silage	32·0
Barley	19·6
Oats	25·8
Dairy Cake (65% S.E. at £30 per ton purchased price)	46·2

*These calculations refer only to the cost of producing the various feeds up to the stage where they are available on the farm. The additional expenditure involved in feeding them to livestock will vary widely from farm to farm but, from the limited evidence available, it appears that they are not likely to modify significantly the comparisons of costs of production of S.E. set out above.

derived from grazing was calculated as the residual after deducting the starch equivalent value of all other feeds from the conventional theoretical requirements for maintenance and production. This method assumes that there is no wastage in the feeding of concentrates or other feeds. In practice there are many farms feeding heavily with concentrates—in order to attain high yields—which show an extremely low, or even negative, contribution from grazing during the winter months on this method of estimation. The costs shown in the table are therefore intended to show the relative cost of starch equivalent from grazing compared with other forms of nutrients.

Profits from Grassland and Kale

Since grass, grass products and kale were cheaper sources of livestock feed than most other farm crops and purchased concentrates, it might be expected that high profits on dairy farms were associated with a heavy dependence upon grass and grass products. But there are other factors in addition to the costs of production of fodder crops which have a bearing on the relative profitability of different systems of feeding. The yield per acre and the suitability of the feed for the cow's production ration must also be considered in determining the most profitable feeding system. Nevertheless, the results of the investigation showed that intensive grassland utilization was a highly profitable proposition.

The 366 herds in the identical sample for 1955–56 and 1956–57 were grouped according to the level of starch equivalent production per acre from grass, grass products, kale and arable silage.* These crops were used for the classification because they were shown to be the cheapest sources of feed nutrients. (Arable silage was included because no distinction between it and grass silage could be made from the farm records.) Some of the farms in the study which obtained a large amount of milk off grass in the summer months only showed a low contribution from grassland because of heavy feeding with hand-fed feeds in the winter. On further analysis these were shown to have a large "negative contribution" from grazing in the winter months. Clearly, such a negative contribution is unrealistic and should not influence the classification of farms. The data were, therefore, re-analysed, treating the winter six months and the summer six months separately, ignoring any negative figures for grassland shown for the winter months. Only in this way could a reasonably accurate ranking of farms be obtained.

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*This analysis was undertaken in conjunction with the Department of Agricultural Economics, Manchester University; the results were published in the Report of the Committee on Grassland Utilization (Cmnd. 547).

Even this method, however, tended to undervalue the contribution of grazing to milk production. In particular, farms which fed concentrates above the so-called theoretical requirements in summer as well as in winter showed a relatively low contribution from grazing and were therefore placed in a lower category of utilized production from grazing than their actual production from grazing would justify. In a sense, this was appropriate, for the failure to achieve a better performance from grassland often stemmed from the lack of realization of what grassland could contribute towards production. Many farmers wasted the resources of grassland by feeding heavily with concentrates at times of the year when grazing alone could be expected to contribute a major share, if not the whole, of the production requirements. It should be stressed that in this analysis the farms were classified according to the utilized production from grass and fodder crops and not merely according to their production of these crops.

Having determined the S.E. production from the acreages of grass, grass products, arable silage and kale used for the dairy herd the farms were classified into the following three groups:

Utilized Production of Starch Equivalent per Acre	*Classification*
Less than 12 cwt	Low
From 12 to 16 cwt	Medium
Over 16 cwt	High

The average production per acre of grassland, arable silage and kale is shown in Table 19. The profitability of improved grass and green fodder production and utilization was clearly demonstrated. It is, of course, unlikely that the higher profits on the farms with the higher production from grass and green fodder were entirely due to better production and utilization of these sources of feed. It is probable that their management was also superior in other directions, such as more careful attention to the rationing of cows. But the fact that higher profits were associated with the better production and utilization of fodder crops demonstrated that these crops can improve profits from dairying for those farmers who are able and willing to adopt the management skills necessary for intensive grass and forage production.

TABLE 19

Profits and Production from Grass, Arable Silage and Kale, 1955–56 and 1956–57

S.E. Production per Acre of Grassland, Arable Silage and Kale	Low	Medium	High
Number of farms	104	165	97
Average S.E. Production per acre of grassland, arable silage and kale	10·4 cwt	13·8 cwt	17·9 cwt
Margin (profit) per acred use for dairying:			
1955–56	£8·1	£11·4	£13·0
1956–57	£6·6	£10·7	£12·8

Profitability of Feeding Concentrates

The foregoing analysis has demonstrated that it pays to increase the production from grass and forage crops.* But there is the further problem whether it pays better to use the increased production to keep more dairy cows or to replace concentrated feed. If more cows are kept the profit margin per cow may not be increased, but the farmer may increase the profit margin per acre used for the cows. Increasing the margin per acre is particularly important on small farms where a reasonable livelihood can only be obtained by achieving high profit margins per acre. On the other hand there is less incentive to obtain high margins per acre on larger farms and the farmers concerned may be more concerned to obtain a high return for every £100 invested in the dairy herd. The distinctions between these measures of profitability are brought out in the following paragraphs.

Some conclusions on this problem were obtained by a further analysis of the information in Table 19. Each group in that table was divided into two according to the level of feeding with concentrates. These three sets of subgroups broadly represented, at each level of grassland fodder production, those farmers who, on the one hand, used grass and fodder crops mainly for maintenance and those, on the other hand, who used grass and fodder crops to a greater extent for the production part of the cow's ration. The results of this analysis are given in Table 20.

The reasons for many of the conflicting views on the most profitable levels of yields and quantities of concentrates to feed are explained by this table. First, it should be noted that milk production was profitable whether produced at low cost per cow (£83–85) with little feeding of concentrates or produced at high cost per cow (£104–108) with the feeding of greater quantities of concentrates. Correspondingly, there was not much difference in the margin per cow for the group with an average yield of 717 gallons and the group with an average yield of 896 gallons per cow. It should be also noted that higher

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*This conclusion is substantiated by other studies. See, for example, Profits from Dairy Farming: I.C.I. Bulletin No. 7, 1956.

TABLE 20

Returns and Costs related to a Varying Emphasis on Fodder Crops and Concentrates. Identical Sample, 1955–57

Level of Grass and Fodder Production and Utilization	Low		Medium		High	
Level of feeding with concentrates	Low	High	Low	High	Low	High
	(Col. 1)	(Col. 2)	(Col. 3)	(Col. 4)	(Col. 5)	(Col. 6)
1. No. of Farms	52	52	82	83	49	48
2. S.E. production per acre of grassland, arable silage and kale (cwt)	10·3	10·6	13·6	14·0	17·6	18·2
3. Per cent of all feed from these crops	67·3	48·9	69·2	56·4	71·8	60·2
4. Acres used for dairying per cow	4·2	3·3	3·3	2·8	2·8	2·3
5. Yield per cow (gal)	717	847	746	884	759	896
6. Concentrates per cow (cwt)	16·8	29·9	17·5	28·7	15·6	27·1
7. Returns per cow (£)	110·2	130·7	117·4	138·9	118·6	139·1
8. Costs per cow (£)	82·5	104·1	84·9	105·0	83·8	107·9
9. Margin per cow (£)	27·7	26·6	32·5	33·9	34·8	31·2
10. Yield per acre (gal)	173	260	227	321	271	390
11. Concentrates per acre (cwt)	4·1	9·2	5·3	10·4	5·6	11·8
12. Return per acre (£)	26·6	40·2	35·6	50·2	42·3	60·5
13. Costs per acre (£)	19·9	31·9	26·7	38·0	29·9	47·0
14. Margin per acre (£)	6·7	8·3	9·9	12·2	12·4	13·5
15. Returns per £100 costs (£)	134	126	139	133	142	129

production and utilization of grass and kale were associated with substantially higher margins per acre whether the level of concentrate feeding was above or below average.

The indications were, however, that at each level of grass and forage production higher profits per acre were associated with higher rates of concentrate feeding. Where the production from grassland was low, reasonable profits per acre were only achieved with relatively high feeding of concentrates. In such cases concentrates were used to make up for the technical difficulties and shortcomings in the grassland management.

Having demonstrated that, under the price and cost condition of these years, the feeding of concentrates increased farm profits particularly if the production of grass and forage crops was poor, the next problem is whether it was more profitable to use any increases in forage production to replace concentrates or to feed more cows. Lines 3, 4 and 6 of Table 20 showed that on the farms with a low level of concentrate feeding, any increases in forage production were used to keep more cows since neither the proportion of grass and forage per cow increased nor did the consumption of concentrates per cow decrease with greater production of grass and forage crops. Lines 9 and 14 showed that such a move was profitable. On the other hand, a comparison of columns 2 and 3 or columns 4 and 5 showed that increases in forage production could be profitably substituted for concentrates if the feeding of concentrates was at a high level.

The last two lines of the table (lines 14 and 15) illustrate another facet of the problem. Although increased consumption of concentrates increased the margin per acre at all levels of forage production the returns per £100 costs were less for the high-concentrate group compared with the low-concentrate group at each level of forage utilization. In other words, the high-concentrate feeding herds obtained greater margins per acre by accepting a lower return for each £1 spent on the dairy herd, than was obtained by the low-concentrate feeders.

Influence of Changing Prices and Costs

The economy of substituting grass and forage crops for concentrates is obviously not the same under all conditions of prices and costs. In particular, the price of milk and the cost of purchased concentrates, each of which is beyond the control of the individual producer, have a marked influence on the optimum system to be adopted. It may be seen from Table 20 that the farms depending heavily on concentrates had, in each group, the higher output of milk per cow and per acre devoted to dairying. Any change in the price of milk would therefore affect those farms to a greater extent than those which depended more upon fodder crops for production. Since, by definition, they used more concentrates they would also be affected to a greater extent by fluctuation in the prices of concentrates. The magnitude of this effect upon profits per acre in each group is illustrated in Table 21. With a falling price of milk the balance of advantage tends to swing in favour of forage feeding, by about *7s. 0d.* in the low forage group and by as much as *10s. 0d.* per acre in the high forage group, for every penny drop in the milk price. A fall of £1 per ton in the price of concentrates favours the high concentrate producers by some *5s. 0d.* to *6s. 0d.* per acre.

TABLE 21

The Effect of Changing Prices on Profits per Acre of Different Systems of Feeding

	Low Forage		Medium Forage		High Forage	
	Low Concen-trates	High Concen-trates	Low Concen-trates	High Concen-trates	Low Concen-trates	High Concen-trates
Change in profit per acre as a result of:						
1*d*. per gal change in milk price	14*s*. 5*d*.	21*s*. 8*d*.	18*s*. 11*d*.	26*s*. 9*d*.	22*s*. 7*d*.	32*s*. 6*d*.
£1 per ton change in concentrate prices	4*s*. 1*d*.	9*s*. 2*d*.	5*s*. 4*d*.	10*s*. 5*d*.	5*s*. 7*d*.	11*s*. 11*d*.

Density of Stocking

It has already been shown (line 4 of Table 20) that the number of acres required per cow may be reduced by either improved utilization of grass and forage crops or increased use of purchased concentrates, and either of these methods was seen to be profitable. (A further method, discussed in Chapter VI, is to reduce the numbers of followers being reared as dairy replacements.) The range in the stocking density—from 1⅔ acres to more than 4½ acres per cow—is shown in Table 22. Although the increased density of stocking was not associated with higher margins per cow, it did result in considerably higher margins per livestock acre. Family incomes, in particular, were much higher on the intensively stocked farms. This was partly a reflection of organization of the smaller acreage farms, where very intensive stocking was practised. On the other hand, the less intensively stocked farms were able to earn as much, or more, for each £100 spent on the dairy herd.

TABLE 22

Variations in Stocking Density 1955–57

Livestock Acres* per Cow	2 and Under	2–2·5	2·5–3	3–3·5	3·5–4	4 and over	All Herds
No. of Herds	54	77	98	87	53	57	426
Rent per Acre	£3 16*s.*	£2 16*s.*	£2 17*s.*	£2 12*s.*	£2 5*s.*	£2 1*s.*	£2 11*s.*
Livestock Acres per Cow	1·7	2·2	2·7	3·2	3·7	4·7	3·0
Gallons per Livestock Acre	487	350	300	258	213	179	268
Margin per Cow	£25 3*s.*	£32 5*s.*	£31 14*s.*	£31 9*s.*	£32 11*s.*	£34 12*s.*	£31 15*s.*
Margin per Livestock Acre	£14 17*s.*	£15 8*s.*	£11 12*s.*	£9 16*s.*	£8 17*s.*	£7 9*s.*	£10 9*s.*
Family Income per Stock Acre	£23 7*s.*	£18 3*s.*	£14 2*s.*	£11 14*s.*	£10 8*s.*	£9 0*s.*	£12 19*s.*
Returns per £100 Costs	£126	£134	£134	£132	£136	£137	£133

*Livestock Acres are the acres of grass, cereals, roots and other crops grown for the milking herd and followers.

Feeding Silage

In view of the rapid increase in silage production in recent years, an attempt was made to measure the influence of silage feeding on the profitability of milk production. Silage was fed on one-half of the farms in the sample—at an average rate of nearly 50 cwt per cow, and appeared to be more popular on the larger farms.

There was no indication that the consumption of concentrates was influenced by the volume of silage feeding. Indeed, silage appeared to have been fed primarily as a substitute for hay, and, to a lesser extent, for roots and green fodder. Since high-quality silage might be substituted for some of the concentrates in a cow's production ration, this result suggested either that there was wasteful feeding of good quality silage or that the quality of the silage produced was only comparable with the normal quality of hay.

Neither was there any indication that the quantities of silage fed had any direct influence on costs, yields or margins obtained. Perhaps this result was to be expected since the tendency was to feed silage as a substitute for other forage crops rather than concentrates. Also, since the cost of silage, even when fed in relatively large quantities, was only a small proportion of the total costs of milk production, any influence that silage feeding might have had was masked by other influences.

The increasing popularity of silage can therefore be attributed more to its integral part in improved grassland management rather than to any direct effect is has on production costs. Where, however, silage occupies a prime role in the feed economy of dairy herds—as in some herds where self-feeding is now practised—it might well have an important direct effect on production costs. Silage can be made when unsuitable weather conditions preclude hay-making, and any excess production of grass during the summer months can be readily conserved for winter feeding. It has already been demonstrated that improved grass and forage production can be profitable for dairy farmers. To the extent that silage making is part and parcel of improved grass production and utilization it follows that the production and efficient use of silage is profitable on many dairy farms.

Importance of Checking Feed Use

Various systems of feeding dairy cows have been examined in detail, and the relative profitability of the different systems has been discussed. But there is one factor of great importance whichever feeding methods are adopted; and that is the need to keep a check on the quantities of feed fed to the cows. It has already been noted that on some of the farms in the sample, there was a "negative contribution" from grazing in the winter months—i.e., the hand-fed feeds apparently provided more than the theoretical feed requirements. Admittedly, some of the theoretical requirements themselves are under criticism at the present time, and the method of assessing the contribution from grazing is not beyond question. Nevertheless the fact remains that some farmers feed a much greater quantity of feed to produce a given quantity of milk, than do their neighbours. Even in the early summer months when grazing is most productive, some farmers feed generous quantities of concentrates, along with the grazing. A survey by the Milk Marketing Board of England and Wales in the last week of May, 1957, showed that in a random sample of 989 milk-recorded herds, 89·4 per cent were being fed concentrates, mainly purchased dairy cake, at the average rate of 1½ lb per gallon produced.* It is highly probable that wasteful feeding practices are commonly followed. To some extent farmers are hampered by the lack of established scientific data on the results of different feed practices. But in any case, many farmers are not fully aware of the actual amount of feed consumed by their cows. A number of simple check-sheets have been prepared in recent years to enable farmers to compare the feeding levels of their herds with standards achieved by other farmers. An example of such an annual check-sheet is "A Guide to the Feed Economy of the Dairy Farm"† which has helped many farmers to find and correct weaknesses in their feeding practices. The use of this check-sheet invalues estimates of annual feed consumption by the milking herd in relation to milk yields. Consequently it provides guidance only over a period of a year or more. A variety of daily check-sheets are also used by farm advisers. These checks are very simple to make at any time of the year and, again, have helped many farmers to improve their profits from milk production. Typical of the effect of these simple checks is the following observation by an adviser: "The farmers' reactions have always been good whether pleased or displeased with their own showing. They have been interested and have asked a good many questions. It has stimulated a number of them into feed recording."

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*Report of the Committee on Grassland Utilization, (Cmnd. 547), p. 13.

†Published by the Department of Agricultural Economics, Wye College, Ashford, Kent, available free on request.

Many farmers know little more about the quantity of milk produced by each cow than they do about the quantity of feed consumed by it. In consequence, wasteful feeding practices may be due as much to not knowing how many gallons are produced as they are to feeding too much per gallon. Of the 414 herds costed for the year 1956–57, milk recording was practised on 338. These milk recorded herds produced an average margin per cow of £39 2*s*., compared with £20 4*s*. for 76 herds where milk recording was not practised. Of course, the difference in the margin per cow was not due solely to milk recording which was but one of the methods used by the more successful farmers to maintain and improve the profits from milk production. Nevertheless, the information obtained by milk recording frequently helps to check such other aspects of milk production as the use made of feedingstuffs. And the opportunities to improve profits from milk production by greater control over the quantities of feed used under existing feeding systems are as great on many farms as the opportunities to adopt improved feeding systems.

Conclusions

The various conclusions on the economy of feeding dairy cows may now be drawn together. Under the prices and costs in 1955–57, grass, grass products and kale were the cheapest sources of feed for dairy cows, and increased production and utilization of these crops was shown to be associated with higher profitability. The increased production could be used to improve profits in one of two ways. If concentrates were being fed at a relatively high level then it was profitable to substitute grass and forage for some of the concentrates. On the other hand, if concentrates were not being fed at a high level then profits could be improved by using the extra forage production to keep more cows. It was also shown that at three levels of grass and forage production higher profits per acre were made at the heavier rates of feeding concentrates, although profits per cow tended to be reduced and there was a lower return per £100 costs. Also, any decreases in the price of milk tends to swing the balance of advantage away from heavy feeding of concentrates towards forage farming. Profits per acre were increased by heavier stocking densities, although there was no corresponding increase in the rewards for every £1 spent. Finally, it was pointed out that accurate control of the actual feed used, and accurate knowledge of the amount of milk produced, could improve profits on many farms as much as changes in feeding systems.

In terms of farming advice, these conclusions may be summarized as follows:

(1) Improved production and effective utilization of grass and forage crops is profitable for all types and sizes of dairy farms.

(2) On small farms with limited acreage of land, and probably limited accommodation for additional cows, profit margins per acre at 1955–57 prices could be maximised by intensive grass production, keeping as many

cows as the buildings or the capital resources would allow and supplementing the high production of grass and forage crops by feeding concentrates for much of the production ration.

(3) On larger farms where the pressure to obtain the highest possible profits per acre is less, and where capital rather than acreage is the limiting factor, the returns per £100 costs could be maximised, at 1955–57 prices, by intensive grass and forage production and utilization, supplemented by limited feeding of concentrates.

(4) Any decreases in the price of milk from the 1955–57 level or increases in the prices of concentrates would be to the relative advantage of intensive grass feeding compared with heavy dependence upon purchased concentrates.

(5) On many dairy farms, profits may be improved as much by better control of existing feeding methods, as by adopting new feeding techniques; and recording sheets for helping to achieve better control are readily available.

V. LABOUR USE IN DAIRYING

The large variations in the amount of manual labour used per cow have already been mentioned in Chapter III. It was pointed out that relatively more labour per cow was used on the smaller herds, particularly where most of the work was done by the farmer and members of his family. It was suggested that if the smaller farmers fully appreciated the value of their labour they would put some of the many hours spent looking after the cows to more constructive use in other farm activities.

But the results of the study showed not only that more labour was used per cow in the small herds compared with the larger herds; there were also big differences in the labour requirements per cow in herds of a similar size. Table 23 gives details.

TABLE 23

Variations in Labour Used per Cow in Herds of Different Sizes. 1956–57

Size of Herd	Under 10	10–19·9	20–29·9	30–39·9	40–49·9	50–59·9	60 and over	All Herds
Labour Hours per Cow	No. of Herds							
Under 100	2	26	17	15	21	9	13	103
100–139·9	11	58	42	20	19	6	12	168
140–179·9	17	37	23	3	4	1	3	88
180–219·9	16	7	5	1	–	–	1	30
220–259·9	11	2	3	–	–	–	–	16
260 and over	7	1	1	–	–	–	–	9
All Herds	64	131	91	39	44	16	29	414

It might be expected that more labour per cow would be required in the high yielding herds than in the low yielding herds; but any such relationship was concealed by the variations in the labour used in herds with similar yields. There is no doubt that some of the farmers could reduce the amount of time spent milking and feeding the cows and cleaning out the cowsheds and yards. Although the records obtained during the study did not contain sufficient detail to show exactly how the labour routines could be improved, various studies in recent years have pinpointed common reasons why the labour routine in dairy herds is often longer than it need be.*

First of all, the milking operation itself on average accounts for about 40 per cent of the total time spent in looking after dairy cows, yet cows milked per man-hour vary—even with the use of a milking machine— from about 10 to 30 or more. The poor results achieved on many farms are due either to an excessive time taken to milk each cow or to poor organization behind the cow. Excessive milking times may be traced to inadequate stimulus for milk "let-down"; some mechanical weakness of the machine, or failure to remove the machine as soon as milking has ceased. There is a variety of explanations for a poor routine behind the cows. Inconvenient lay-out is usually blamed, although a well-planned routine in a badly designed cowshed can be more efficient than a poor routine in an up-to-date milking parlour. The distances covered in carrying materials and milk can often be reduced with little or no alteration to the design of the buildings or dairy. Another frequent cause of a low output per man-hour is when two or more men are employed in milking. Unless each man is working independently there is often overlapping of tasks with one man waiting for the other. Work study investigations have shown how the organization of milking can be improved with consequent reductions in the time and effort required for the milking routine.

There are similar explanations of excessive time spent in other operations associated with the cows—washing and sterilizing utensils, feeding the cows and cleaning the cowsheds. Manual labour is expensive and measures to reduce the distance materials have to be carried by hand are usually worth while. The following questions indicate the points to which attention might be given, with useful results.

Where cattle are wintered in cowsheds are the feeding and cleaning routines as simple as possible? Can a ramp be made so that dung can be tipped directly into a trailer? Many man-hours per week can also be lost in badly designed cattle yards; but it is possible to devise reasonable work routines even in yards with an inconvenient layout. Is too much straw used, and is the time needed to spread it excessive? Perhaps the open area of the yard is unnecessarily large. Are the bulk feeds such as hay or silage stored adjacent to the yard or, if this is not possible, are several days' supply brought to the yard by trailer? Can the livestock be fed from outside the yard? Has the possibility of self-feed silage been considered? There are almost invariably some improvements to the work routine which are worth considering; and these questions are typical of the type of enquiry which is usually well-rewarded.

The time spent in looking after calves is also excessive on many farms. One reason is that calves are often scattered in any available boxes around the farm buildings, with the result that feeding is inconvenient and time-consuming. The labour routine could often be improved if all the calves could be housed in one building; and over a period of time such small improvements as feeding yokes or brackets for holding buckets can save a substantial amount of labour.

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*See, for example, "Planning the Farm to Save Labour," by F. G. Sturrock and G. H. Brayshaw. Report No. 47. Farm Economics Branch. School of Agriculture, Cambridge.

A final explanation of the long hours spent with the cows on many small family farms is the lack of alternative work on the farm, especially during the winter. It is not always immediately apparent that the saving of a few minutes here and there in the daily round of chores can build up cumulatively into periods long enough to enable other useful and productive jobs to be done, and the physical strain of work reduced. Time is too often undervalued. Profits per cow do not increase in proportion to any increases in the time the farmer spends in and around the cowsheds; and these additional hours could be more profitably used in other directions—feeding pigs or poultry, repairing mechanical equipment or even sitting in the house examining the past results of the farm business and preparing future management plans.

The labour routine in dairying is much more simple than the feeding system or the herd replacement policy followed on a dairy farm. There are few difficult problems in deciding whether one method is more profitable than another. Generally speaking, any methods which reduce the labour requirements per cow tend to lead to higher profits. Details of ways in which labour may be saved vary from farm to farm and can only be worked out according to the circumstances of individual farms. But improvements in the labour routine in milk production is relatively simple and straight-forward method of improving herd profits on many dairy farms.

VI. HERD REPLACEMENT POLICIES

The principal purpose of this chapter is to review the evidence emerging from the study concerning methods of providing herd replacements. In the first instance it is instructive to examine some of the reasons for the disposal of cows from dairy herds, for at current rates of disposal, the keeping of cows for an additional lactation would reduce the costs of replacement, on average, by some 20 per cent.

Table 24 shows the distribution of cows in the sample according to the number of completed lactations at the end of each recording period.

More than 70 per cent of the cows in the investigation had not completed more than three lactations—and two-fifths had not completed more than one lactation. These proportions have been characteristic over many years. Certainly the length of useful life cannot be regarded as an important reason for the disposal of dairy cows from the herds in the sample.

Reasons for the Disposal of Cows from Dairy Herds

The reasons why one quarter of the cows left the herds each year are given in more detail in Table 25. Some of the returns were not explicit on the precise causes of disposal and some interpretation of the records was necessary. No doubt there was also a certain amount of overlapping of the categories. For

TABLE 24

Distribution of Cows According to Number of Completed Lactations 1955–57

No. of Completed Lactations	*Per Cent of Cows*
0	18·0
1	20·5
2	17·9
3	14·8
4	9·6
5	6·9
6	4·9
7	3·3
8	2·0
9	1·1
10 and over	1·0
	100·0

TABLE 25

Reasons for the Disposal of Cows from Milking Herds, 1955–57

	No. of Herds		426	
	Av. Size of Herd		26·3	
	Av. No. of Disposals		6·7	
		Av. No. of Completed Lactations	Av. Value at Disposal	
Reasons for Disposal:	%		£	s.
Mastitis (incl. Summer Mastitis)	3·7	3·6	32	1
Sterility, Abortion, Brucellosis	23·1	3·6	40	19
Test Failure and Tuberculosis	4·1	4·0	38	3
Johne's Disease	1·7	2·5	13	13
Other Diseases	5·8	3·3	15	3
All Diseases	38·4	3·6	38	6
Accident or Injury	4·9	3·2	15	10
Old Age	6·4	8·0	28	17
Low Production	26·7	2·6	46	14
Sold for Dairying	21·8	2·2	63	4
Other Reasons	1·8	2·8	32	11
Total	100·0	3·3	42	14

instance, some of the cows sold for dairying probably had performance records which were not all that might be desired by the farmers who disposed of them. One fifth of the cows were sold for further milking and one quarter were sold because of low production—many probably going into other dairy herds. Disease of one sort or another was the reason for a further two-fifths of the disposals. Sterility and abortion were by far the most important diseases reported as reasons for disposal. No estimate could be made from the result of the study of the annual costs of these diseases, but the fact that they were responsible for about one quarter of all the disposals from the herds indicates that the annual costs to the industry must be very high. Of course, the high proportion of disposals due to disease and the relatively low prices realised for the animals do not reflect the full costs of the diseases to dairy farmers. High medicinal and veterinary charges, lower milk yields, and the need to rear more replacements, are additional aspects in which disease increases costs and reduces profits from milk production. Given the heavy cost of replacements and the relatively low disposal values, every effort should be made to extend the productive herd life of cows. The difference between the purchase price of a heifer (say £80) and the average cull price of a barren or diseased cow (say, £40) represents an annual depreciation of £20 per cow if the animal is retained for only two lactations. But if an average of six lactations can be obtained—and cows do not normally achieve their highest yields until the sixth lactation*—the annual depreciation is reduced to about £6 10*s*. This illustrates one way in which dairy profits may be disappointing even if feeding and labour practices are satisfactory.

Herd Depreciation Costs

The range in annual depreciation costs per cow was shown in Table 17. Whilst depreciation costs per cow were more than £12 on some farms, other farmers obtained an appreciation per cow of £4 or more. To understand how this could occur, it is necessary to consider briefly the method of calculating depreciation costs.

Herd depreciation costs are the differences between opening valuations at the beginning of the year plus purchases and the closing valuations plus sales. The general basis of herd valuations was cost to the farmer. Home bred heifers entering the milking herd were charged at cost of production, and purchased cows were valued at purchase price and carried at that valuation until disposed of. Disposals were entered at realised market values. Also included in the depreciation account, as an offset to the herd depreciation, were the market values of calves born during the period of the investigation.

The reasons for the wide variation in the depreciation costs now emerge. First, farmers who had to dispose of a relatively high proportion of their cows at low prices because of death or disease incurred heavy losses in the value of their dairy herds. These losses per cow were especially great if the animals had been purchased at relatively high prices or if they had been costly to rear. On the other hand, farmers who had to dispose of very few or no cows because of disease, or indeed, sold a few cows each year at a profit i.e., for more than the animals cost to rear, might well find the herd appreciated in value. This might occur because young stock became available which were of better quality than older cows that were at or past their peak and though still likely to fetch a good price, were not up to the standard of that normally bred. In this way they were able to offset losses incurred in the sale of old cows at the end of their productive life. It may be argued that these farmers were making profits from the rearing and sale of dairy cattle and that such profits should not be regarded as reducing the costs of milk production. Nevertheless, many dairy farmers successfully followed the practice of selling one or two prime cows each year to offset the depreciation of the older cows in the herds. Obviously this policy is not open to all dairy farmers, but there are certain areas in which the combination of rearing with milk selling is traditional. The depreciation of the dairy cows was also offset on some farms by the sale of calves at high prices. The general question whether it is more profitable to rear or purchase replacements will be considered later, but it is appropriate at this stage to point out that whereas bobby calves of most dairy breeds only fetched some 30*s.* to £2 per head, cross-bred calves with a beef sire had market values of £10 or more per head. In some circumstances, and in some areas more than others, it is much easier at the present time to obtain an extra £10 or so per cow by the use of a beef bull than by purchasing more concentrates to obtain higher yields.

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*Milk Marketing Board Production Division Report No. 5, 1954.

Thus, depreciation costs were kept low—or an appreciation item was shown for the dairy herd on many of the farms in the sample—by reducing the wastage from disease, by selling a few cows at a profit to offset the depreciation of the remainder or by obtaining good prices for the calves. The depreciation of a herd can make substantial differences to the level of profits obtained; and means of reducing the depreciation costs to a minimum are often overlooked when attention is focussed too rigidly on the feeding and labour aspects of milk production.

Costs of Rearing Replacements

Information was obtained from the farms in the sample about the costs of rearing dairy replacements. All the costs relating to the young stock being reared for the dairy herds were recorded e.g., food, grazing and labour. Since records were not kept for individual animals and did not extend over the whole rearing period some conventional division of the costs between the various age groups of young stock was necessary. This was done by dividing the total rearing costs during the year by the number of animals reared—thereby obtaining estimates of the annual costs of rearing a replacement animal. On the basis of those annual replacement costs per animal it was therefore possible to value, at cost of production, young stock on the farm at the beginning and end of the costing period. Estimates could then be made of production costs of any heifers transferred to the milking herd, by deducting from the total annual costs of the young stock the increase in the value of young animals still being reared at the end of the costing period. Any profit (or loss) from the sale or death of young stock was also credited (or debited) to the milking herd.

In this rather complicated way, estimates were made of the costs of rearing heifers for herd replacements. For all the farms in the sample, the average cost per heifer transferred to the dairy herd was £71 15*s.* (or £67 7*s.* when no charge was made for the manual labour of the farmer and unpaid members of his family). Even for the smallest herds when little employed labour was used the average cost per heifer was £54 7*s.* when no charge was made for family labour (or £70 3*s.* when a charge was made for family labour).

As with the cost of milk production itself there were wide variations in the cost of rearing heifers for milk production. A number of detailed studies of these variations have been made in recent years and two of the main reasons for the variations in rearing costs have been shown to be the amount of whole milk fed to young calves and the age at which heifers calve. On the first point, a study by Dinsdale and Winter* showed that rearing on milk substitutes was considerably cheaper than relying entirely on whole milk. One of the conclusions of the study was that:

> The cost of rearing a heifer up to calving could be lowered appreciably on some farms by the introduction of a substitute for whole milk during the first or second week. This is being done on a few farms in the study with quite satisfactory results. One lb of a recognized milk substitute will replace approximately one gallon of milk and even at £5 10*s*. per cwt or 1*s*. per lb is a cheaper method of rearing than feeding whole milk which could be sold at anything from 2*s*. per gallon in May to about 3*s*. 8*d*. in December, plus any quality premiums that are due.

The study also showed that rearing costs could be materially reduced by calving heifers at an early age. Heifers calving between 2 and 2¼ years old cost some £9 less to rear than heifers calving at more than 2¾ years old. The authors concluded:

> Calving heifers at an earlier age would reduce rearing costs. At the commencement of this investigation the majority of co-operators stated that they calved their heifers at 2½ years or under. It was found, however, that the heifers that were being costed were nearly 2¾ years old when they calved. This seems to indicate that some farmers are under the impression that their heifers are calving down at 2½ years old when in fact they are two and three months older. If this is the case, then a closer check on ages should be adopted, as the two or three months longer keep before calving would probably raise the cost by £3 or £4 per head.

Some farmers believe that there are advantages in both rearing calves on whole milk and allowing heifers to become more mature before calving. Any such advantages should be weighed against their additional costs before accepting them as desirable for profitable milk production.

Rearing or Buying Replacements

A reason frequently given for rearing replacements, particularly by smaller farmers with limited capital resources, is that capital, which is not available to buy heifers, is gradually accumulated through the growth of the young stock. To some extent this is correct since a heifer worth, say, £75 may be produced for some £54, or even less if no charge is made for the manual labour used in growing feed crops for the young stock. But the £75 represents something approaching three years' income and the land and the labour used for the young stock could often be used in more profitable ways—additional milk production in many instances. Whether it is more profitable to rear replacements or to buy them depends not so much on a comparison of the costs of production and the purchase price as upon the alternative uses which could be made of the resources used for heifer rearing.

Even on the smallest farms in the study more than 50 per cent of the replacements were home-reared. A much greater proportion—80 to 90 per cent, were home-reared in the larger herds. Table 26 shows the acres of crops and grass used for rearing replacements for herds of various sizes.

With the exception of the smallest herds, there was approximately one acre of crops and grass used for rearing replacements for every cow in the milking herd. Even with the smallest herds, where shortage of land is frequently given as the reason for not increasing cow numbers, some 4½ acres were, on average, used for rearing replacements.

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*D. H. Dinsdale and T. Winter. Cost of Rearing Dairy Heifers from Birth to Calving. Durham Univ. Fm. Econ. Branch, Kings College. Report G 53.

Would this land, together with the labour and other materials used in heifer rearing, produce a greater profit if used to keep additional milking cows or to rear beef stores? No general answer can be given; so much depends upon the organization and the equipment available on individual farms. A comparison of the relative profitability of rearing dairy heifers and beef stores may be made fairly easily on most farms since the rearing costs are broadly the same and the relative profitability depends mainly on the value of the heifers compared with market value of the beef animal together with any subsidies which would be received for beef animals.

TABLE 26

Acres of Crops and Grass Used for Rearing Replacements 1955–57

Size of Herd (cows)	0– 9·9	10– 19·9	20– 29·9	30– 39·9	40– 49·9	50– 59·9	60 & over	All Herds
Av. Size of Herd	7·4	14·8	24·5	34·6	44·4	54·7	71·8	25·9
Av. No. of Heifers transferred to Milking Herd	1·4	3·3	5·8	10·1	9·5	13·8	17·0	6·3
Av. No. of Acres used for Rearing Replacements	4·4	13·3	19·6	34·6	35·5	49·2	64·6	23·3
Av. Family Income per Acre used for the Milking Herd	£ s. 20 12	£ s. 25 4	£ s. 21 14	£ s. 24 18	£ s. 22 10	£ s. 21 2	£ s. 22 15	£ s. 23 4

A comparison of the relative profitability of heifer rearing and keeping more dairy cows is less simple. More labour is required for dairy cows than young stock, better accommodation is required and there are more out-of-pocket expenses. On the other hand it has already been shown in this report that the labour used per cow in small herds is often high, and more cows could probably be kept without any additional labour. As may be seen from Table 26 family income per acre used for the milking herd was some £20 to £25 per acre. Since the value of a down-calving heifer may be in the region of, say, £75–£80 and three to four acres are used for each heifer transferred to the milking herd, the annual output per acre used in heifer rearing is only £20–£25. From this has to be deducted the value of purchased feed and milk fed to the young stock, say, £10 per acre, and the family income per acre works out to be considerably lower than the family income per acre used for the milking herd. On the smaller farm where it is necessary to obtain as high a family income per acre as possible, it is difficult for a farmer to obtain as large a family income from rearing young stock as from keeping additional cows, provided that accommodation can be found for the cows. Not until a family income of £20 to £25 per acre can be obtained from rearing young stock on the smaller farm is the practice likely to be as profitable as keeping additional cows. On larger farms where managerial and labour difficulties may increase if more cows are kept and the return per £100 invested may be more important than the income per acre, then heifer rearing may be as profitable as additional milk production. Also, some rocky and unploughable land, particularly on hill farms, is only suitable for store rearing. In any case, however, the relative profitability of rearing or purchasing replacements can be calculated fairly easily by preparing budgets of the likely costs and returns from heifer rearing or from additional cows under the circumstances of an individual farm.

With the forthcoming eradication of tuberculosis, the risk of disease from purchased stock is diminishing. Other diseases are still prevalent, however, and many farmers prefer to rear their own replacements as a precaution against bringing disease on to their farms. But the premium being paid, in the form of reduced profits, for such security against disease is very high on many farms.

Finally, improvements in the profitability of store rearing for beef production in recent years has led to higher prices for dairy replacements as the number of dairy heifers being reared falls below the numbers required as herd replacements. As this occurs rearing for herd replacements becomes more profitable, particularly for the larger-scale farmers. The smaller farmer will continue to need as high an income as possible from every acre of his farm, and that will be achieved by producing milk rather than rearing dairy replacements.

SUMMARY

1. This report summarizes the results of a national investigation into the economics of milk production carried out between October 1955 and September 1957. Information was obtained in respect of more than 400 dairy herds of various sizes throughout England and Wales. Although the sample of farms studied was not necessarily representative of all aspects of dairying in the country, it was broadly representative as far as size of herd was concerned and it reflected the relative importance of dairying in different parts of the country. In addition to details of costs and returns under different systems of production, information was also collected about the breeds of cows kept and the buildings and dairy equipment available on the farms in the sample.

2. The results from an identical sample of farms in 1955–56 and 1956–57 showed a decrease in the net cost of production from £97 to £92 12*s.* 0*d.* per cow, owing mainly to reduced expenditure on purchased foods. In the earlier year, almost 3½ lb of concentrates were fed for each gallon of milk produced. But partly resulting from the wet season and open winter of 1956–57, which favoured the growth of grass and fodder crops, the consumption of concentrates fell to 3·0 lb per gallon in the second year. However, although yields had increased slightly, the returns per cow were also lower in the second year mainly because of the depressing effect on the pool price of increasing quantities of milk which could only be sold for manufacture. Consequently, the margin per cow fell from an average of £34 in 1955–56 to £29 9*s.* in 1956–57. Owing to increases in cow numbers, the margin per herd did not decline as greatly as the margin per head. Nevertheless, there was a reduction

of some £75 from £870 to £795—in the average margin per herd between the two years.

3. Costs in both years ranged from less than 1*s.* 8*d.* per gallon to more than 3*s.* per gallon; rather more than 50 per cent of the milk being produced at between 2*s.* and 2*s.* 8*d.* per gallon.

4. A number of farmers who co-operated in the study had taken part in a similar investigation in 1951–52. For an identical sample of 145 farms in 1951–52 and 1955–57 the average size of herd increased by four cows or 15 per cent; while milk yields increased by 11 per cent from 718 gallons to 798 gallons per cow. The average number of hours required per cow declined by more than 20 per cent—from 141 hours to 112 hours. Consequently the average margin per herd in 1956–57 was virtually maintained at the 1951–52 level despite increases in feed prices and wage rates and a decrease in the average returns per gallon.

5. Although there were several differences in production methods between large and small herds, there was no evidence that the smaller-scale farmers were unable to compete successfully in milk production with their larger-scale competitors. The relatively low income of the smaller dairy farmers was due more to the small scale of their businesses than to any relative inefficiencies in their methods of milk production.

6. There was little conclusive evidence from the results of the investigation about the relative profitability of concentrating on the production of either winter or summer milk; the most profitable alternative depending mainly upon the amount of milk which could be obtained from summer grazings.

7. To a large extent, the variations in costs, returns and margins from milk production arise from differences in feeding practices and yields obtained. Although there is a tendency for higher profit margins to be associated with higher yields, high yields at any cost are not profitable. The cost of feeding a cow giving high yields has an important influence on profit margins; only if the food requirements can be provided relatively cheaply is the objective of high yields per cow a profitable proposition for dairy farmers.

8. The variation in the amount of labour used per cow was a further important reason for the variation in the profitability of milk production. The conclusion was drawn that substantial economies in the use of labour were possible, particularly on some of the smaller farms where the absence of alternative enterprises caused the farmers to spend many more hours looking after their dairy cows than were needed on the larger farms.

9. Grass grazed was by far the cheapest form of nutriment, followed by grazed kale. Root crops were shown to be a relatively expensive form of winter feed compared with cereals and grass products; but all the sources of home-produced feed if produced and used efficiently appeared to be cheaper than purchased dairy cake.

10. The profitability of improved grass and green fodder production and utilization clearly demonstrated that these crops can improve profits from dairying for those farmers who are able and willing to adopt the management skills necessary for intensive grass and forage production.

11. On small farms with limited acres of land and probably limited accommodation for additional cows, profit margins per acre at 1955–57 prices could be maximized by intensive grass production, keeping as many cows as the buildings or the capital resources of the farmer would allow and supplementing the high production of grass and forage crops by feeding concentrates for much of the production ration.

12. On larger farms where capital rather than acreage is the factor which limits the level of profits the returns per £100 costs could be maximized, at 1955–57 prices, by intensive grass and forage production and utilization supplemented by limited feeding of concentrates.

13. Any decreases in the price of milk from the 1955–57 level or increases in the price of concentrates would be to the relative advantage of intensive grass farmers compared with farmers heavily dependent upon purchased concentrates.

14. On many dairy farms, profits may be improved as much by better control of existing feeding practices as by adopting new feeding techniques; and recording sheets to help to achieve better control are readily available.

15. More than 70 per cent of the cows in the investigation had not completed more than three lactations, and two-fifths had not completed more than one lactation. Consequently, the length of useful life could not be regarded as an important reason for the disposal of cows from the herds in the sample. Disease of one sort or another was the reason for two-fifths of the disposal; sterility and abortion being by far the most important disease problems on the dairy farms.

16. Herd depreciation costs were kept low—or an appreciation item was shown for the dairy herd on many of the farms in the sample—by eliminating disease as far as possible, by selling a few cows at a profit to offset the depreciation of the remainder, or by obtaining good prices for the calves.

17. At the level of prices in 1955–57 the rearing of young stock for herd replacements, particularly on the smaller farm, was less profitable than the production of milk itself.

Note.—Detailed tabulations of the results of this investigation for the period October 1955 to September 1957 will be made available to the seasonal workers on application to the Milk Marketing Board (Production Economics Department) or the Agriculture Economics Division of the Ministry of Agriculture, Fisheries and Food.

APPENDIX

Names and Addresses of Provincial Agricultural Economists

ADDRESS	COUNTIES
Northern (Newcastle) E. M. Carpenter, M.A., King's College, Farm Economics Branch, 8 Kensington Terrace, Newcastle-on-Tyne, 2.	Cumberland Westmorland Durham Northumberland
North Eastern (Leeds) W. H. Long, M.A., Department of Agriculture, The University, Leeds, 2.	Yorkshire
East Midland (Nottingham) The Provincial Agricultural Economist, Agricultural Economics Department, Nottingham University School of Agriculture, St. Michael's House, Sutton Bonington, Loughborough, Leics.	Derby Leicester Lincoln (Kesteven) Lincoln (Lindsey) Nottingham Rutland
Eastern (Cambridge) F. G. Sturrock, M.A., B.Sc., School of Agriculture, Cambridge.	Bedford Cambridge Essex Hertford Huntingdon Isle of Ely Lincoln (Holland) Norfolk Soke of Peterborough Suffolk
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Weighing concentrates
(Photo. Farmers Weekly)

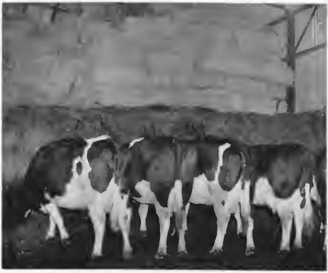
Recording milk yields
(Photo: Imperial Chemical Industries Ltd.)

PLATE I

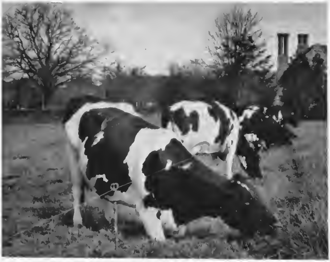
Applying fertilizer to grass
(*Photo: Imperial Chemical Industries Ltd.*)

Silage making
(*Photo: Imperial Chemical Industries Ltd*)

PLATE II

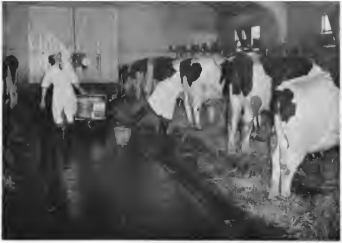


Cattle feeding on silage with an electrical wire control in a Dutch barn.
Straw bales are stored above.
(*Photo: Imperial Chemical Industries Ltd.*)

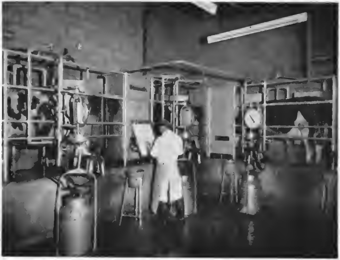


Cattle strip-grazing
(*Photo: Imperial Chemical Industries Ltd.*)

PLATE III



Section of the two-row byre of Danish design
(*Photo: Farmers Weekly*)



Two-level, three-stall tandem milking parlour
(*Photo: Imperial Chemical Industries Ltd.*)

PLATE IV